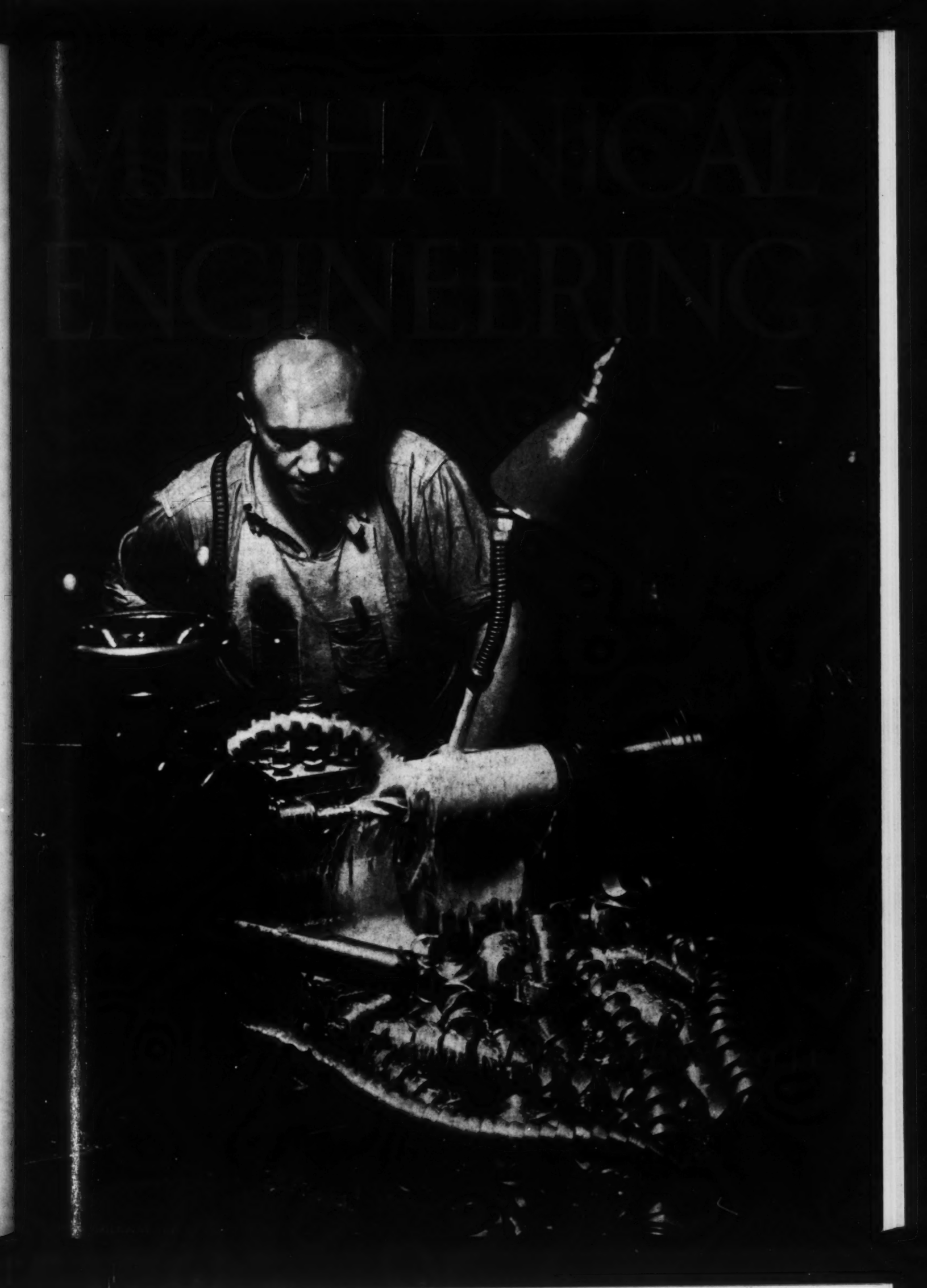
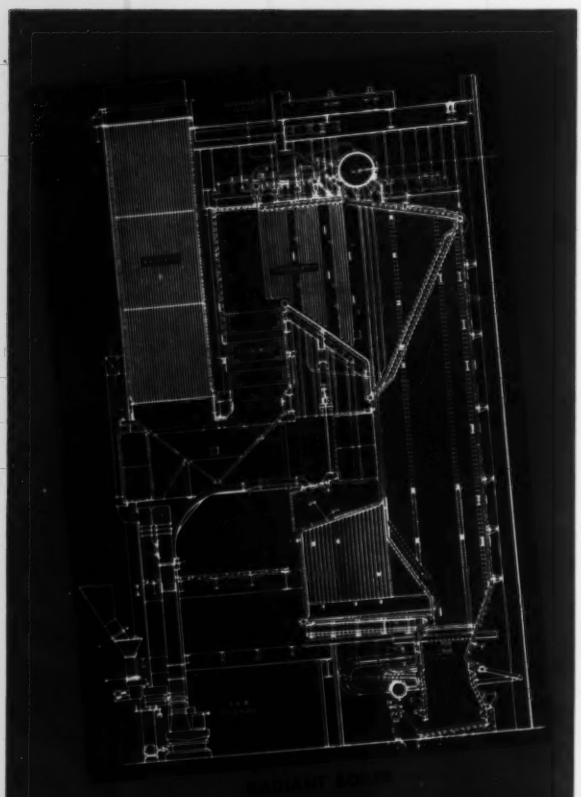


WATER-COOLING OF BOILER FURNACES

assures Better Service



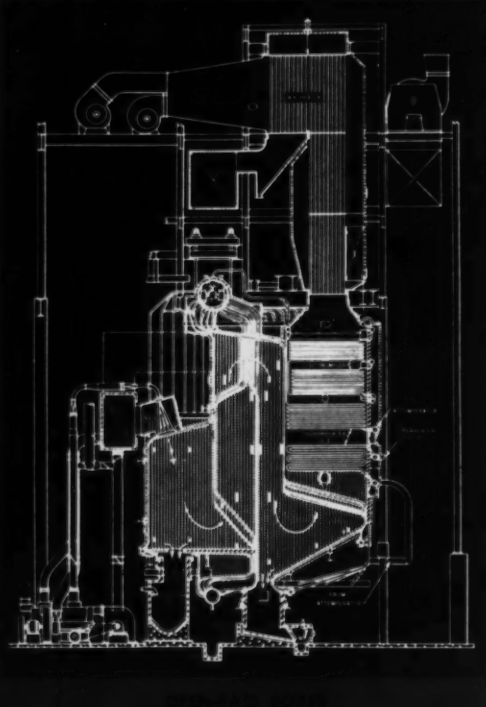
In the all-out defense effort, steam plants in many cases are driven at rates that severely test the reliability of the boiler furnaces. More than ever, therefore, furnace constructions should be of designs and materials that will withstand continuous gruelling punishment.

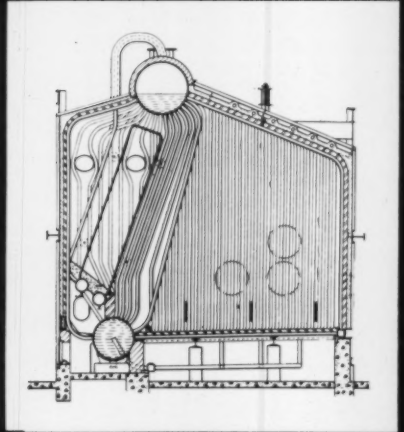
B&W Water-Cooled Furnace Constructions provide a high degree of immunity to operating difficulties under such conditions. They not only meet all requirements of load and structural conditions but also, through their versatility, serve widely varying purposes in different wall areas of individual furnaces. Some areas promote combustion, others temper gases. Some constructions facilitate removal of ash in liquid form, others condition ash for removal in dry form. The fundamental details and safety factors necessary to proper operation are inherent in the designs.

These features are so fundamentally necessary in present-day boilers that they are the basis of the design of the Integral-Furnace, the Radiant, and the Open-Pass Boilers, in which a large portion of the heat absorption takes place in the furnace or in open passes. They are available with other designs of B&W Boilers, to meet exacting operating requirements for all methods of firing.

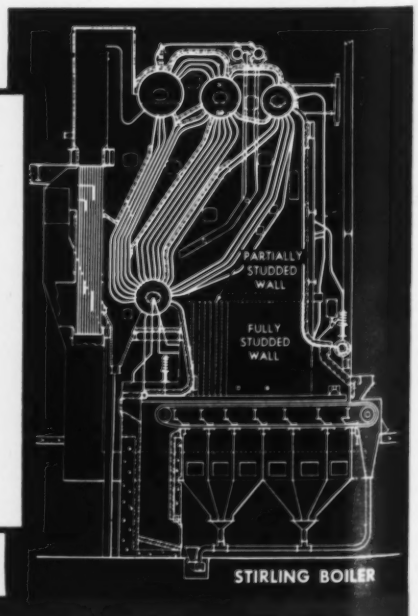
Complete details are in Bulletin G-16, Water-Cooled Furnaces, available on request.

THE BABCOCK & WILCOX CO.
85 LIBERTY ST. NEW YORK, N. Y.





INTEGRAL-FURNACE BOILER



STIRLING BOILER

BABCOCK & WILCOX

G-213

MECHANICAL ENGINEERING

Published by The American Society of Mechanical Engineers

VOLUME 63 NUMBER 12

Contents for December, 1941

MACHINING SHELL WITH CARBIDE TOOLS	*M. F. Judkins*	859
ROLE OF INDUCTION HEATING IN WAR PRODUCTION	*F. T. Chesnut*	861
HONING TOOLS AND RELATED EQUIPMENT	*L. S. Martz*	865
UTILIZATION OF STEAM PASSENGER LOCOMOTIVES	*A. A. Raymond*	870
A DEVELOPMENT IN THE MANUFACTURE OF ICE	*B. F. Kubaugh*	875
PROGRESS IN RAILWAY MECHANICAL ENGINEERING, 1940-1941		879
1941 ANNUAL REPORT TO E.C.P.D.	*R. E. Doherty*	893
E.C.P.D. HEARS MEMBERS' VIEWS		896
MATERIAL SPECIFICATION PRINCIPLES	*F. G. Jenkins*	900
THE SHIFTING CONTROL OF INDUSTRY	*D. L. Palmer*	904

EDITORIAL	857	A.S.M.E. BOILER CODE	921
BRIEFING THE RECORD	906	REVIEWS OF BOOKS	924
COMMENTS ON PAPERS	914	A.S.M.E. NEWS	926

INDEX TO ADVERTISERS 58

OFFICERS OF THE SOCIETY:

WILLIAM A. HANLEY, *President*

W. D. ENNIS, *Treasurer* C. E. DAVIES, *Secretary*

PUBLICATION STAFF:

GEORGE A. STETSON, *Editor* FREDERICK LASK, *Advertising Mgr.*

COMMITTEE ON PUBLICATIONS:

C. B. PECK, *Chairman*

F. L. BRADLEY A. R. STEVENSON, JR.

C. R. SODERBERG E. J. KATES

ADVISORY MEMBERS OF THE COMMITTEE ON PUBLICATIONS:

W. L. DUDLEY, SEATTLE, WASH. N. C. EBAUGH, GAINESVILLE, FLA. O. B. SCHIER, 2ND, NEW YORK, N. Y.

Junior Members: C. C. KIRBY, NEW YORK, N. Y., AND F. H. FOWLER, JR., CALDWELL, N. J.

Published monthly by The American Society of Mechanical Engineers. Publication office at 20th and Northampton Streets, Easton, Pa. Editorial and Advertising departments at the headquarters of the Society, 29 West Thirty-Ninth Street, New York, N. Y. Cable address, "Dynamic," New York. Price 60 cents a copy, $5.00 a year; to members and affiliates, 50 cents a copy, $4.00 a year. Postage outside of the United States of America, $1.50 additional. Changes of address must be received at Society headquarters two weeks before they are to be effective on the mailing list. Please send old as well as new address. . . . By-Law: The Society shall not be responsible for statements or opinions advanced in papers or . . . printed in its publications (B13, Par. 4). . . . Entered as second-class matter at the Post Office at Easton, Pa., under the Act of March 3, 1879. . . . Acceptance for mailing at special rate of postage provided for in section 1103, Act of October 3, 1917, authorized on January 17, 1921. . . . Copyrighted, 1941, by The American Society of Mechanical Engineers. Member of the Audit Bureau of Circulations. Reprints from this publication may be made on condition that full credit be given MECHANICAL ENGINEERING and the author, and that date of publication be stated.

Courtesy Allis-Chalmers Mfg. Co.

Drilling Tube Sheet for Large Steam Surface Condenser

VOLUME, 63
No. 12

MECHANICAL ENGINEERING

DECEMBER
1941

GEORGE A. STETSON, *Editor*

Know Thyself

THERE are probably few intelligent and educated men who do not, from time to time, look at themselves and their careers in a critical mood. Something happens—a wakeful night, a sharp rebuke, failure to perform successfully an important assignment, loss of a job, the secret pang of jealousy at the good fortune of friend or associate, the disappointment over apparently overdue praise or advancement, remorse occasioned by the mistakes of the past—and we set the battered and shriveled character we seem to possess over against that heroic and noble one we had imagined ourselves to be. Such is the panicky kind of self-appraisal that is begotten of weakened morale amid the unhealthful shadows of discouragement.

How much better it would be if men were able to inquire into their purposes, their abilities, and their careers under conditions in which their judgments were not warped by discouragement, disappointment, and self-pity, and by following an orderly procedure just as an engineering problem would be tackled. A personal balance sheet, set up with the purpose of revealing facts and checking a course of action, might, if honestly interpreted, save a man from many future less effective self-revelations. Certainly, the setting up of such a balance sheet of personal appraisal should appeal to the orderly habits of an engineer's mind.

Several years ago, as part of the program of the then newly constituted Engineers' Council for Professional Development, a wise man whose work had brought him into contact with thousands of young men, particularly engineering graduates, drew up an orderly set of questions that constituted what has been called a Personal Appraisal. Thousands of copies of these questions have been distributed by the E.C.P.D. Committee on Professional Training, with the object of helping young engineers to develop concrete plans of development for the early years of their careers in a manner which might help them to use those years in a truly constructive way.

The questions themselves are thorough and searching. They cover "occupation," "professional status," "personal status," and " general program of development." A copy of the questions will be sent without charge to any A.S.M.E. junior member of the ten-dollar-dues class who asks for it. The Committee on Local Sections, which makes this offer, affords junior members an opportunity for intelligent personal appraisal. Why not make use of it?

Do You Know E.C.P.D.?

THE Engineers' Council for Professional Development deserves to be better known than it is. Because it consists of three representatives each of eight constituent bodies, of which The American Society of Mechanical Engineers is one, and because, in addition to these representatives, a mere handful of engineers serves on its committees, personal contact with its program and accomplishments is limited and indirect, and there is lacking that direct interest which dues-paying members have in organizations of other types. Furthermore, the representatives themselves meet only once a year and hence publicity naturally is focused on this annual event. Nevertheless, the Council's work is continuous and has a value that the future will assess more accurately than the present.

Through its publications the A.S.M.E. has persistently featured the E.C.P.D. annual meeting, affording, as will be found by referring to pages 893-899 of this issue, a considerable amount of space to summaries of reports. Attention is directed to these pages; for it is the duty of all engineers to know about and to support the work of E.C.P.D.

An interesting departure from the routine of former E.C.P.D. annual meetings calls for special comment. For this year the major emphasis of the meeting was placed on reports by representatives of the constituent bodies, rather than on the reports of the committees of the Council. These reports were solicited with the object of finding out how the constituent bodies appraise the work of E.C.P.D. and in the hope of obtaining helpful suggestions for future activities. As to the reports of the E.C.P.D. committees, they are available in complete form from the Council's headquarters, and a summary of them is presented in President Doherty's report which we have published in full in this issue.

What Makes It Tick

IT IS impossible to take up a newspaper today without finding a picture or an announcement of one or more huge plants that are being added to the Arsenal of Democracy. A highly industrialized nation, which, in the opinion of many prophets of doom who flourished in the depressed era of the last decade, was overexpanded in its capacity to consume, the nation which instituted mass production and developed a high standard of living by means of it and a system of free enterprise backed up by enormous resources in raw materials and man power,

today finds itself adding to that capacity and utilizing its well-tried methods in defense of its freedom. Yet how few persons there are who comprehend fully what a mass-production industry is like.

The outlines of a broad picture of one segment of the mass-production facilities of the nation have been drawn by K. T. Keller, president of the Chrysler Corporation and member A.S.M.E., in a talk before the Army Industrial College on Sept. 17, 1941. Mr. Keller's talk, "Fitting the Tools of Industry to Defense," is being distributed by the Chrysler Corporation in a little booklet from which a few portions may be quoted.

"It is the country's productivity in terms of modern machines of warfare," says Mr. Keller, "that will decide the outcome of what is going on. That means its skill in conception and design—in other words, its engineering resources; its ability to organize productive equipment and personnel for precision manufacture and quantity output—in other words, its management resources—plus the material resources required for physical production and their proper organization, so that they may flow where they are needed."

Big as such a mass-production corporation as Chrysler really is, Mr. Keller points out, it is fundamentally a collection of small industries. Its four and one half million shares of stock are owned by some sixty thousand persons. Its 19 peacetime plants cover 15½ million square feet of floor area, and are being augmented by new plants which bring this area up to 17 million square feet. Eighty-odd thousand people call for a yearly pay roll of 75 million dollars. Of these 80,000, a supervisory group of 4850 includes 50 manufacturing executives and plant managers; 500 master mechanics, tool, and design engineers; 3000 superintendents, foremen, and assistant foremen; and 1300 engineers, laboratory technicians, designers, and draftsmen. It has more than 15,000 machines used for the manufacture of cars and trucks.

Yet Chrysler is only one of many mass-production enterprises engaged in defense work. Furthermore, large mass-production enterprises like Chrysler make up only a portion of our nation's production capacity. Smaller companies, operating no less effectively if with fewer men in their organizations and by other production methods, are equally important. The mass-production industries, as well as the nation as a whole, must rely on them. They provide the raw and semifinished materials, the machines and tools, and certain component parts of the final assembly.

How a large corporation relies on others was explained by Mr. Keller. "So we take the defense job apart and separate it into its component pieces," he said. "We take each piece and see what has to be done to make one just like it. We ask ourselves which pieces we will make and which pieces we will buy. We decide ourselves to make the ones that call for the most accuracy and precision—where quality is imperative. Of those that we buy, will we buy them from someone else who is already in a position to make them or will we get somebody to set himself up to make them? Is there someone now in business that has the ability and capacity to do the job better or for less than we can do it? We have done a great deal of subcontracting. We do that ordinarily in our automobile business."

These few references to Mr. Keller's picture of a mass-production industry and "what makes it tick" are familiar to engineers. They should give laymen confidence in American industry and also some comprehension of the task involved in changing over from peacetime to national-defense production. The fundamentals involved are the special province of the mechanical engineer—design, production, and management.

Fine Literature

A LITTLE booklet, "Through Engineering Eyes," with the subtitle "Science Selections From Literature," by Allan R. Cullimore, introduces students of the Newark College of Engineering to several of the great writers of all time from Homer and Herodotus to Michael Pupin. Although the selections are made with the object of capturing interest because the subject matter relates to engineering, they serve a wider purpose.

Unfortunately, the curricula of the engineering school cannot afford time for much education in classical literature. Engineering students as a rule are not the type to become interested in the study of literature from the point of view of the scholar. They have, however, the type of mind that recognizes values. Such little direction as the selected readings in President Cullimore's book afford may therefore have the happy effect of opening new horizons to eyes accustomed to modern man-made landscapes. There are few intellectual experiences as exhilarating as discovering for oneself a book that has influenced the world for generations and recognizing the reasons for its survival. To find that the great thoughts of the human race were written down hundreds of years ago and are novel only to the shallow-minded, heedless of their heritage, cultivates humility. On the other hand, the discovery that ideas considered today as being axiomatic were slow in gaining acceptance bolsters faith in humanity and sustains hope for the future.

Even if time were available in engineering curricula for courses in literature, history, and philosophy, the benefits would be lost in many cases by failure on the part of instructors to understand the engineering mind—failures of appeal and approach that sometimes destroy the effectiveness of courses in English which are today considered essential to engineering education. The result is frequently the opposite of what is anticipated and indifference or antipathy is aroused in the minds of young men who set great store by the material and the practical. But there are ways of creating interest in, appreciation of, and enthusiasm for fine literature, such, for example, as extracurricular reading classes conducted in at least one engineering school. Selections such as those made by President Cullimore are another. And even the most material and practical mind will be greatly enriched in times as disturbing as the present by discovering that the world is not facing for the first time the threat of change and that men faced change in the past with clear vision and fortitude.

MACHINING SHELL WITH CARBIDE TOOLS

By MALCOLM F. JUDKINS

FIRTH-STERLING STEEL COMPANY, FIRTHITE DIVISION, MCKEESPORT, PA.

IT HAS been my privilege to visit all of this country's arsenals and armories, as well as many civilian shell-manufacturing plants. It is my purpose to present a survey of shell-machining practice and to make suggestions as to how our national production needs can best be met.

The problem confronting us is maximum shell production with available facilities, such as machine tools, operating personnel, and time. The answer to this problem is in large measure the productivity of sintered-carbide-tipped tools. Conservative figures indicate that the ratio of effectiveness of tungsten in carbide-tipped tools against tungsten used in high-speed-steel tools is one hundred to one. Fortunately, carbide-tipped tools are abundantly available. We are blessed with domestic tungsten ore mined commercially in this country, Our own firm is fortunate in having a producing tungsten mine in Nederland, Colo. There exists in the United States a large capacity for making sintered-carbide tips. While it is true that the tool-making capacity is limited because of the critical need of this type of labor and the specialized equipment which is necessary for producing other defense items, shell manufacturers can easily make their own tools from carbide tips and tool-steel shanks.

COMPARISON OF WORLD WAR WITH TODAY'S PRODUCTION

It is interesting to compare the present and previous situations. Shells produced for World War I, although made in large quantities, were necessarily made at slow rates of production and high costs. Cutting speeds with high-speed-steel tools used 26 years ago were rarely in excess of 45 fpm. Coarse feeds of from $^1/_{10}$ in. to $^1/_8$ in. per revolution were necessary in order to secure the necessary rates. The machines used were largely engine lathes or single-purpose machines. Machine tools designed expressly for machining shell were rebuilt from existing general-purpose machines. The various machining operations necessary to complete the shell from rough forgings were performed successively rather than simultaneously. The use of more than one tool at a time in machining a shell was exceptional. In the previous emergency, the shell cavity was bored and this proved to be the slowest of all the operations, becoming in consequence the most severe bottleneck of the entire undertaking. Stress was laid on bursting characteristics of the shell rather than upon the metallurgy and resulting machinability of the steel used. Despite these very real handicaps, the producers of shell for World War I actually turned out staggering quantities and for this they are to be most highly commended. This result was only possible by marshaling the efforts of a host of civilian producers. We are informed that the various plants of a single industrial concern in the Pittsburgh district produced in excess of 25,000 shell per day of various calibers.

The present shell-production schemes differ in many important respects from the situation which obtained prior to and during the last World War. Shell are being produced today in an almost infinitely greater quantity. So many private firms have installed and are operating equipment producing vast quantities of shell of all calibers that their enumeration is almost impossible. Shell are being made today at a greatly increased rate. Contracts for their manufacture have been widely placed throughout the West and South as well as in the East and North. Many large new plants have been built and literally scores more are either in process of erection or planning.

Today, largely automatic machines are employed. Some of them are expressly designed for shellwork alone. There is a definite trend away from precision automatics which are sorely needed for other more precise defense work, such as the production of airplane-engine parts. The newer shell machines are characterized by simplicity of operation and maintenance which makes possible the use of semiskilled and unskilled personnel after only short instruction. Cutting speeds and feeds practiced upon modern shell extend from approximately 300 fpm at 0.02 in. feed per revolution for rough-turning to about 400 fpm at the same feed for finish-turning. There has been a corresponding improvement in metallurgy and machinability of shell steel. Today, almost all medium- and small-caliber shell are made from a steel similar to WDX-1335, which is a low-carbon, high-sulphur, high-manganese steel of excellent machinability, coupled with highly satisfactory bursting characteristics. Naturally, there is more uniformity in the shell steel today than could have been realized two and one half decades ago. As a consequence the cost of producing shell today averages less than 25 per cent of the cost of producing the same caliber in the same quantities for the last war. Improved forging practice has played a large part in this cost reduction and increased rates of manufacture. Shell forging today favors the upset method, which involves a finished-forged cavity and in many instances a formed boat tail, all of which minimize the necessary machining to convert the rough forging into a finished shell ready for loading. Instead of one or at most two turning tools working on a shell as in the last war, today four or even six are used together, and cutoff, base, and open-end facing, as well as chamfering tools are simultaneously cutting.

Motors for such modern shell lathes are usually of 75 hp capacity.

Instead of lathes on which each step is directed manually by the operator, modern shell lathes which are almost fully automatic are used. Much time is saved by the modern method of embodying the base plate which prevents high-pressure gases from the burning of the propelling charge from entering the shell casing with consequent danger of exploding the detonating charge while the projectile is still in the barrel. Previously, the base of the shell was counterbored and undercut to receive the base plug. Today, a flat metal disk is rapidly spot-welded in place. No machining or fitting is required.

The various armament and production agencies have been

Contributed by the Machine Shop Practice Division and presented at the Fall Meeting, Louisville, Ky., Oct. 12–15, 1941, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

classified as to products. The Frankford Arsenal at Philadelphia, Pennsylvania, has long been assigned the task of fire-control instruments, small arms, and artillery ammunition. Fortunately, the present emergency was anticipated by almost ten years and a decision was then reached to equip the shell shop for mass production, patterned after the automotive industry. In the development of the present layout, the facilities were planned to provide parallel lines of small- and medium-caliber ammunition with roller conveyers and other of the most modern material-handling methods. The machine tools which were selected and purchased resulted from most careful consideration of the most efficient size and type for each unit operation.

Various calibers can be produced including the 5-in. in both 38 and 25 calibers, the 3-in., the 4.2-in. chemical shell, as well as the 37-, 60-, 75-, 81-, 90-, 105-, and 155-mm shell. At the present time the artillery shop is engaged in the production of 5-in. naval antiaircraft, 38-caliber and 75-mm high-explosive shell.

SPEEDS AND FEEDS FOR MACHINING SHELL FORGING

For the 5-in. naval antiaircraft shell, the material is an S.A.E. 1050 forging. The first machining operation conducted with sintered-carbide-tipped tools is rough-turn for concentricity at 260 fpm, 0.020 in. feed per revolution. After nosing or forging the ogive curve and heat-treating, the ogive is rough-turned at 250 fpm, 0.040 in. feed per revolution. Finish-turning of the entire shell casing is conducted at from 240 to 360 fpm at 0.026 in. feed per revolution. Tools are changed for grinding after each 80 pieces. The twenty-second operation upon the shell is the machining of the copper or gilding-metal rotating band. The band is turned at 650 fpm with 0.039 in. feed per revolution. It is grooved and trimmed at 300 fpm, 0.025 in. feed per revolution. Skiving for final shape is done at 300 fpm, and 0.104 in. feed per revolution.

Seventy-five-millimeter high-explosive shell are machined from WDX 1335 upset forgings.

Although everyone admits that the improvement in metallurgy, machinability, and tooling methods enables us to produce shell much faster than our European neighbors, there has been some criticism of our practice involving a finished-forged cavity instead of the internal-boring operation conducted on our shell during the last World War and still practiced by England and most of continental Europe. Proving-ground tests, however, have shown that our finished-forged-cavity shell have a dispersion due to projectiles frequently less than one half of one per cent.

FRANKFORD ARSENAL AID TO SHELL MANUFACTURERS

In addition to the production shell shop, the Frankford Arsenal maintains an experimental department in which each new caliber to be produced is studied. The unit operations and their sequence are planned; tools are designed and made. Machines are assigned to each application, and after tooling, speeds, feeds, and rates are determined. Unlike the larger caliber, 37-mm high-explosive shell are produced in multiple-spindle, automatic indexing machines. Inasmuch as bar stock instead of hollow forgings are used, it is necessary to drill, ream, and tap. This type of tool cannot, at the present time, readily be adapted to tipping with sintered carbide, and in view of the low spindle speeds at which the high-speed-steel drills and taps must operate the outside turning and forming tools are also of high-speed steel, with the exception of the tools for turning and forming the rotating band, which are tipped with sintered carbide.

The Frankford Arsenal provides a most important service to private shell manufacturers. The Office of the Chief of Ordnance has prepared a plan book for each caliber of artillery ammunition. This book is complete, showing suggested plant layout and is specific in every detail, even to specifying the names of machines which are suggested as either typical or most satisfactory for each step. Fully dimensioned working drawings of all tools, gages, and fixtures are included, together with complete shell specifications. Moreover, the operating setup at the Frankford Arsenal shell shop offers an opportunity for private munitions makers to send observers to study methods, tools, and machines used.

GETTING BEST RESULTS FROM CARBIDE-TIPPED TOOLS

We are definitely committed by the urgency of the present situation to the widespread use of sintered-carbide-tipped tools. They are the only real answer to the insistent demands for immediate production of the immense quantity of shell required. Our objective is therefore to realize the maximum usefulness from these tools. It has been the common lot of many who are now for the first time machining shell with carbide tools to experience extensive breakage in the early stages. In every case following a period of intensive observation and improvement in technique of handling and application, this breakage has virtually disappeared. This means that careful planning and careful checking preceding manufacture can obviate in large measure all but negligible tool breakage. Today, it is taken for granted that machine tools are designed to use sintered-carbide-tipped tools, but, particularly on the new single-purpose machines expressly designed for shell machining, many of the constructional features must be carefully checked. Overhang of tool-slides at or near the end of the stroke may easily lead to deflection sufficient to chip the cutting tool. Stops should be so located that they do not cause the tool block to tilt at the end of the stroke, as this likewise may involve serious tool trouble. Both the volume and method of application of the cutting fluid should be carefully observed. A flood of cutting fluid must be thrown directly upon the tool point at all times that the machine is operating. Any dribble or spray of cutting fluid striking a hot tool tip will cause the hard metal tip to crack. Modifications in the fluid system, including adjustment of the valves which control the flow, should be locked so that the operator cannot shut off the fluid to indulge his own comfort in avoiding spattering. Coolant pipes should be rigidly attached to each moving tool block so that the position of the stream is fixed. If insufficient dispersion of the fluid results from the original nozzle, another flatter nozzle with more lateral coverage should be provided.

Most shell lathes are equipped with live or ball-bearing centers. The action of these should be carefully studied, as in some instances the thrust of the tools tends to lift the shell from the tailstock center, stopping its rotation.

Shell forgings themselves should be carefully examined and inspected. If excessive variation is noted with respect to size, concentricity, hardness, and scale, the shell should be carefully sorted so that each type may be run through as a unit under conditions which can be varied to suit the case. The appearance of a badly eccentric shell in the midst of a lot of concentric forgings may destroy an entire set of carbide tools. A hard shell, resulting from abnormal cooling, may likewise cause serious difficulty. Such irregularities must be isolated for separate treatment.

With regard to the cutting tools themselves, there exists a very real need for standardization to avoid unnecessary delays. A wide range of accurately sized, cold-drawn shank steel sections is available, and there is practically no excuse for designing a shell tool with shank dimensions not to be found in this standard-size group, except, obviously special items such as skiving

(Continued on page 869)

ROLE *of* INDUCTION HEATING *in* WAR PRODUCTION[1]

By FRANK T. CHESNUT

AJAX ELECTROTHERMIC CORPORATION, TRENTON, N. J.

INDUCTION heating, inaugurated during World War I, finds itself an indispensable tool in the waging of World War II. While many mechanical innovations such as warplanes and tanks made their appearance for the first time during the earlier conflict, World War I must be considered a war of men, whereas the present conflict is much more a war of machines and production. The part man power is playing in the present war, however important on the battlefield, is more important than ever before in the shops and factories behind the lines. Airplanes of greater speed, carrying power, or maneuverability; tanks with rugged, trouble-free engines; guns with more fire power; projectiles with higher velocities, penetration, or shattering effect; and machines, for one reason or another, more effective than those of the opponent, are urgently sought. In all of these things, induction heating has been a contributing factor of no small degree, as a few examples will show.

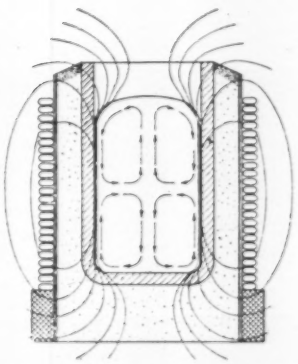


FIG. 1 SECTIONAL VIEW OF AJAX-NORTHRUP INDUCTION FURNACE SHOWING STIRRING ACTION IN MOLTEN CHARGE AND THE MAGNETIC FIELD

INDUCTION HEATING IN CENTRIFUGAL CASTING OF GUNS

Almost since the advent of the modern field piece, gun barrels have been fashioned from ingots, forged, heat-treated, and machined to shape. The larger guns are still made this way. Since about 1930, however, the centrifugal casting method has been supplanting the old method, especially for certain classes of ordnance.

By the centrifugal casting method, the ingredients which make up the steel for the barrel are melted in an induction furnace where the melting and alloying is fast and where melting losses are low. The metal is then carried in the furnace as a ladle and poured into a horizontally rotating mold. See Fig. 3. The rotation of the mold is continued until the casting has become solidified. The gun barrel thus formed is removed from the casting machine, after which it is heat-treated, rough-machined, expanded by a cold-working process, and finish-machined.

In the casting operation several items are noteworthy. First, because of the centrifugal forces involved, the barrel is formed not as a solid ingot requiring an expensive hollow-forging or machining operation but one already having a hole through its center. Second, any slag particles or impurities which may have found their way into the mold, being lighter than the steel of which the barrel is made, are floated to the bore, by pressure of the metal against the mold, where they are removed when the barrel is machined.

It may be said conservatively that by the centrifugal casting method a better gun can be made at much less cost and in very much less time than by methods heretofore employed.

FORGING, BRAZING, AND HEAT-TREATING SHELL

Induction heating is particularly adapted for forming, brazing, and hardening operations in making projectiles. For such work, the main advantages are speed and uniformity of heating, the ability to control the heat to specific patterns, freedom from scale, the relatively small floor space required, an improvement in working conditions for the operator, and the fact that the equipment as a whole can be turned to peacetime operations without loss of investment.

In forging a 75-mm shell, the operations are about as follows: Long bars of S.A.E. X1340 steel of $2^3/_8$ in. diam are delivered to the shears where they are cut into lengths, each sufficient to form two shells. To avoid brittle fracture on shearing, the bars are sometimes preheated to about 200 F. Representative disks are cut from each end and are ground and etched in 50 per cent by volume of hydrochloric acid to check the stock for pipes and seams. The blanks are then fed one end at a time into

FIG. 2 HIGH-ALLOY-STEEL INGOTS BEING CAST FROM INDUCTION FURNACE

(Courtesy Carpenter Steel Company)

[1] The furnaces and processes described in this paper are developments of the Ajax Electrothermic Corporation under the patents of Edwin F. Northrup (Figs. 1 and 2). The term "induction furnace" in each case should be understood to refer to the Northrup rather than to other types of induction furnaces.

Contributed by the Metals Engineering and Machine Shop Practice Divisions and presented at the Fall Meeting, Louisville, Ky., Oct. 12–15, 1941, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

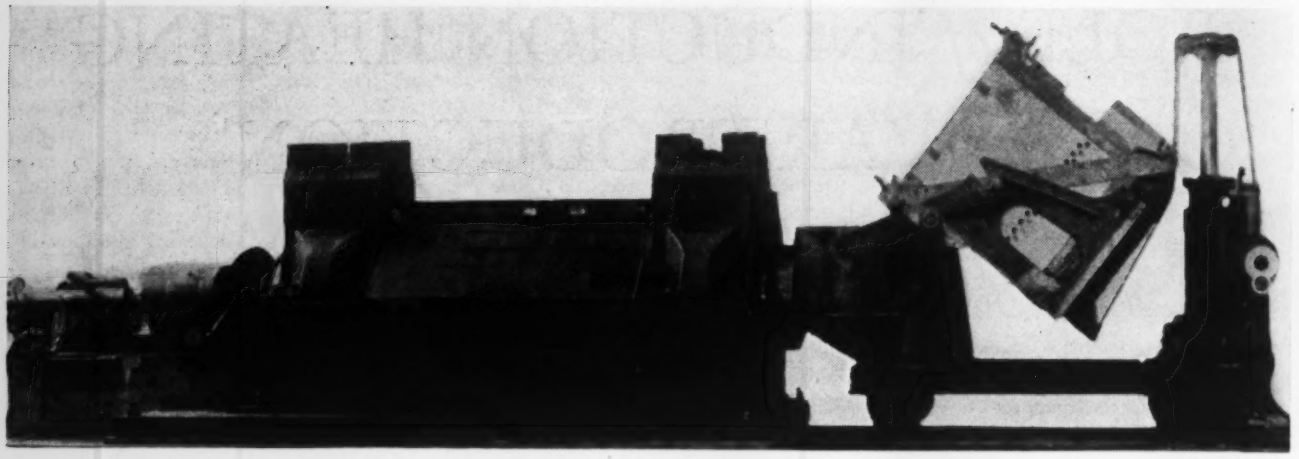


FIG. 3 CENTRIFUGAL GUN-CASTING MACHINE WITH INDUCTION FURNACE IN POURING POSITION
(Courtesy U. S. Ordnance Department)

induction-heating furnaces where they are heated to 2350 F for forging (Fig. 4). There are five induction heaters for each forge machine and, with an individual heating time of 2 min and 20 sec, the furnaces are capable of supplying a heated blank to the forge machine every 28 sec. Each heater is adapted to draw 80 kw at 400 volts, and at a supply frequency of 2000 cycles. While a frequency of 1000 cycles would be sufficient for the work, the higher frequency was selected because of its more ready applicability to automotive work on smaller-diameter pieces at a later date. The furnaces are adapted to heat the bar uniformly over the part to be forged from end to end and from surface to center.

During the heating cycle, power is set and timing is automatic. The power factor, though varying somewhat on each individual heater, is constant on the supply generator. The power required for heating is about 0.22 kwhr per pound of metal heated.

After heating, the bars are forged by the displacement piercing method in upsetting-type forging machines using multiple-cavity dies. Because of the rapid heating, only a soft scale forms on the billet and the wear on the dies is appreciably less than with bars heated by other methods. Although the first cost of the induction-heating equipment is high, the unit heating cost per shell is lower than with other methods because of the short time cycle, longer die life, and less time out for repairs and die changing. In addition, there is no heat loss or operator discomfiture around the induction furnaces.

After the hot-forging operation the shell is trimmed from the blank, rough-machined, cold-nosed in a 350-ton press, finish-

FIG. 4 INDUCTIVELY HEATED BAR BEING FORGED INTO A 75-MM SHELL (FURNACE WITH BAR BEING HEATED AT LOWER RIGHT)
(Courtesy The Iron Age)

machined, banded, reinforced with a welded butt plate, inspected, marked, painted, and shipped to the filling station.

An operation generally comparable to the forging of shells is the nosing of larger shells and bombs. The same advantages exist for these jobs, but usually the heating coils are arranged with graduated or spaced turns to heat the blanks more at the end than farther down in the piece. This is done to prevent "petticoating" or bulging of remote parts under the pressure of the dies. Some shells are nosed in a single-stroke press while others are shaped by a swedging operation. Bombs are made from seamless tube and are spun to shape.

One producer in making a 5-in. antiaircraft shell from a 5-in-diam, $^{9}/_{16}$-in-wall steel blank, heats $1^{1}/_{2}$ in. at the end to 1850 F and tapers the heat off to a visible temperature 6 in. back in the piece. The voltage across the coil is 400 and the frequency 960 cycles. Heating time at 75 kw is $1^{1}/_{2}$ min per shell but a group of three furnaces supplies a blank to the forging machine at the rate of one every 30 sec. A single-stroke 250-ton hydraulic press is used for the nosing operation.

The same producer, in making a 100-lb bomb from 8-in-diam, $^{3}/_{16}$-in-wall steel tubing, heats the nose end to 2250 F for a distance of 6 in. and tapers the heat off to a visible temperature in a total of 11 in. For the tail end, 5 in. is heated to 2150 F and a total of 9 in. is heated to visibility. After heating, the respective ends are spun to shape. The heating coils are arranged with graded turns and operate at 400 volts and 960 cycles. Heating time is $1^{1}/_{2}$ min for each end but 100 kw are applied to the nose while only 75 kw are used for the tails.

FIG. 5 HEATING BLANKS FOR NOSING 155-MM SHELLS
(Courtesy U. S. Ordnance Department)

Adapters for chemical shells, formerly welded, are now brazed and the heat is supplied by induction. The surfaces are prepared, a ring of brazing compound is placed in position, the assembly is inductively heated, and the parts are forced together. Heat is localized at the point of use and a seal is made in 74 sec with but 10 kw of 12,000-cycle power. With the previous welding process, the time cycle was 4 min and the seal never could be considered sure. By the induction brazing method, the seal is 100 per cent sure.

Some armor-piercing shells are point-hardened by an induction process. Because of the tendency of high-frequency current to travel at the surface of conductors and because a great amount of energy can be crowded by induction into a small localized area, it is possible to heat the point and end surface of a projectile to the quenching temperature without affecting the substructure. The heating and quenching operations require only a matter of seconds and handling can be entirely automatic, giving a large output with a small equipment outlay. One 6-kw 40,000-cycle laboratory equipment is capable of hardening a 37-mm shell point every 15 sec with a daily output of over 4000 shells.

FIG. 6 SURFACE HARDENING PATTERNS ARE CONTROLLED BY POWER, TIME, AND FREQUENCY OF INDUCED CURRENT

APPLICATIONS TO AIRPLANES, TANKS, AND SUBMARINES

The surface hardening described for armor-piercing shells finds a multiplicity of applications in engines and parts for airplanes, tanks, submarines, boats, armored cars, and the like. By an induction-heating and hardening process, the surface of a crankshaft bearing, for instance, can be so hardened without affecting the toughness of the steel below the surface that the bearing will last ten times longer before attention than it would without such treatment. While the frequency, power, and time of heating vary widely for dif-

ferent articles or size of pieces treated, a bearing of $1^1/_2$ in. diam and length can be surface-hardened to a depth of $^3/_{32}$ in. with 150 kw of 2000-cycle current in less than 10 sec.

The process is equally applicable to internal and external surfaces and finds use for such applications as crankshaft and camshaft hardening, hardening of shafts, rolls, pins, gears, valve stems, and seats, the internal surfaces of engine cylinders, the integrally formed bearing races for wheel hubs, and the like. In each case and for hundreds of other applications dealing directly or indirectly with the military effort, the heating of the surface is so fast that the desired hardening operation can be achieved before the substructure can be affected by conducted heat.

Besides surface hardening, induction heating is used for zone hardening of gun and motor parts and plays a prominent role in many brazing and forging operations in connection with such parts. Induction heating is used frequently to expand a part later to be shrunk onto another piece and sometimes to heat such a part to remove it from the base piece.

The nickel-chromium wire used for spark plugs and the tungsten contact points used with practically all gas motors are melted in induction furnaces. Similarly, all of the Alnico magnet steel used in the radio and meter parts is exclusively an induction-furnace product. Much of the flexible shafting connecting the meters and the flexible tubing used to protect control wires is inductively annealed before use and many parts of the meters themselves have inductively brazed parts.

Nearly all of the external airplane bearings are of a lead-bearing copper alloy made in the induction furnace because it is about the only furnace in which no segregation takes place.

In the radio and control apparatus all of the vacuum tubes are inductively heated during sealing to drive off occluded gas from the metal parts.

MISCELLANEOUS APPLICATIONS

No attempt has been made to discuss or even to list all of the applications of induction heating or melting in the war effort, but a few applications not directly concerned with guns, shells, and motorized equipment are deserving of mention.

Induction melting furnaces are used in substantially all of the navy yards, arsenals, and private manufacturing plants where special alloys and castings are made. These furnaces, because of their inherent mixing characteristics and fast melting, find favor wherever the steel or alloy to be melted is of a fussy or exact analysis, where it has expensive ingredients, or where speed is essential. Stainless steels and corrosion-resisting alloys are commonly melted in these furnaces, as are most of the high-speed steels and carbides used for cutting tools. Many valves and fittings of both bronze and steel and especially high-pressure bronze castings for naval torpedoes are made from induction-furnace metal.

In addition to the production units, many industrial and governmental laboratories use induction furnaces for experimental study of wartime emergency problems.

Induction furnaces operating from normal frequency current are used for low-temperature heating applications such as the heating of autoclaves or chemical vats for hydrogenation processes where the presence of a flame or spark might be disastrous.

High-temperature induction furnaces, operating at temperatures exceeding 4000 F, are used for the graphitization of carbon bodies and for the fabrication of tungsten carbide and high-melting-point metals for tools, dies, and the like, and, experimentally at least, new methods are in operation for the recovery of magnesium metal from the base ores.

Finally induction furnaces are used to turn out the dollars with which the service forces are paid and to make the razor blades which keep their beards mowed down.

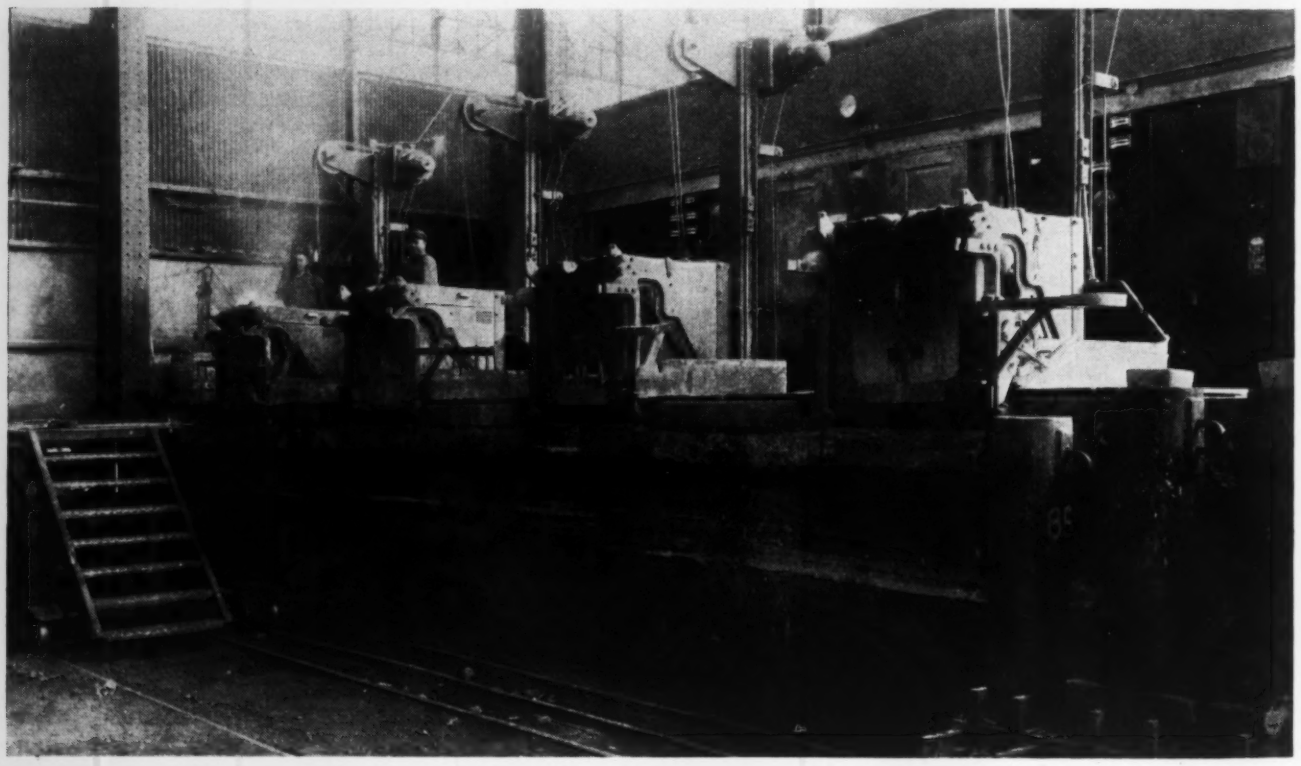


FIG. 7 A BATTERY OF INDUCTION MELTING FURNACES FOR MAKING HIGH-GRADE ALLOYS
(Courtesy Carpenter Steel Co.)

HONING TOOLS *and* RELATED EQUIPMENT

By L. S. MARTZ

MICROMATIC HONE CORPORATION, DETROIT, MICH.

I—FUNCTIONS OF THE HONING PROCESS

BECAUSE honing is used chiefly to generate final finished surfaces in bores and on some cylindrical parts in high production, its functions comprise several combined results in one process, as follows:

1 The correction of errors resulting from previous processing operations and the generation of final geometric and dimensional accuracy within extremely low tolerance, ranging from fifty millionths to not more than one thousandth of an inch, for diametric roundness, diametric straightness, and axial straightness.

2 The generation of final dimensional size accuracy coincident with geometric accuracy, within conventional tolerance ranging from 0.0005 in. to 0.002 in. as may be required.

3 The generation of any desired type of surface finish and any desired degree of surface-finish accuracy with maximum surface quality as it may be specified for functional operating conditions involving parts design, loading, speed, and lubrication.

4 The control in one process of rapid and economical stock removal consistent with accomplishment of the foregoing results under conventional high-production conditions. This comprises stock removal ranging from 0.0001 in. to 0.040 in. or 0.050 in. on the diameter in bores ranging from $^1/_4$ in. diam $\times$ $^1/_4$ in. long, up to 20 in. or 30 in. diam $\times$ 75 ft long, and at rates varying upward to approximately 65 cu in. per hr.

II—SOME MAJOR REQUIREMENTS OF SURFACE GENERATION

SURFACE QUALITY

Factual study of surface generation and surface quality originated about ten years ago, in 1930-1931, with the development of the profilograph instrument at the University of Michigan. This instrument employs the tracer-point principle and produces a photographic trace record of a surface profile, mechanically recorded to any convenient scale of horizontal and vertical magnification.

Measurement and analysis of thousands of profilograms of various types of surfaces, produced by various kinds of cutting tools on various kinds of materials, have revealed the existence of the qualitative as well as the quantitative character of surface roughness. A definite relationship between the character of surface roughness and the method used in producing such roughness has also been revealed. In machining process and frictional wear, this relationship is based solely and obviously upon the fundamental principles of mechanical work required in final processing and the final surface generated either by stock removal or by plastic deformation, or by both.

In other words, when a piece of metal is processed by some type of treatment which fashions it into a desired form and size, it must be deformed, as by compression or tension, or stock must be removed from it as in shear. This deformation or stock removal is accomplished by machines or tools "which serve to transmit and modify force and motion so as to do some desired work."

The amount of work produced is, of course, the product of the force and the distance over which it is applied.

The quality of the work produced is directly proportional to the manner in which force is applied, or the direction and rate of motion used in its application.

These fundamental principles establish the inseparable relationship which exists between the boundry limit of a surface and the adjacent underlying material which supports the work done by the boundary limit, in other words, the surface quality of any generated or "run-in" surface.

Industrial engineering and production personnel have found it advisable to evaluate finished surfaces in terms of surface quality, since operating frictional wear and deterioration due to fatigue constitute a continuing quality-changing process between bearing surfaces. Since the boundary limit of a surface is rarely static in functional operation, the material below the boundary limit should preferably have fixed or controlled characteristics for maximum mechanical efficiency. This is directly related to the manner of force application in finish processing.

PLASTIC DEFORMATION

Plastic deformation, as accomplished by compression in rolling or burnishing and by tension in drawing operations, not only deforms the shape of a part but also deforms its metallurgical structure, usually in the presence of severe frictional heat and stress. The amount of work done represents the application of tremendous force, which acts usually through a distance of not more than a few thousandths of an inch. Force application is necessarily concentrated at successive high points on a surface, thus creating minute areas under intense unit stress and sufficiently high heat to cause some degree of casehardening in the resultant surface.

The service value of this type of surface finish and quality is said to depend upon the maintenance of a bond between this casehardened layer of deformed material and any undisturbed crystalline material which supports it. Under such conditions, the quality of the boundary limit itself is of relatively minor significance.

STOCK REMOVAL BY SHEAR

Shearing action in any amount requires the application of pressure combined with motion. Shear is produced only by stressing material beyond its rupture or fracture point. In doing this work some adjacent material is usually stressed beyond its yield point, and a region of structural deformation is formed which impairs the efficiency of the boundary surface. Successive machining operations, while removing all or part of this deformed material, may generate new regions of similar deformations, dependent upon the manner of force application.

The extent of this stressing below the actual boundary limit

Presented at the National Defense Meeting, St. Louis, Mo., Sept. 9-11, 1941, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

of fracture is particularly noticeable in some motion-picture photoelastic studies of cutting action made by Hans Ernst of the Research Department of the Cincinnati Milling Machine Company. These pictures further reveal that different types of surface-finish characteristics can be generated under identical feeds and speeds by varying only the cutting fluid.

Stock removal by shearing action is therefore conditional upon the degree of balance between a combination of factors comprising the amount of pressure or feed; the distance in motion required to cause fracture of the material; the direction of force application, i.e., whether continuously in one direction, reciprocating, or multidirectional; the time or interval between fractures; the efficiency of thermal dissipation resulting from fracture; and the contributing phenomenon of cutting-fluid efficiency.

It is not only possible but it is common practice to juggle these factors in a number of combinations to produce a number of results in any one method of mechanical processing. It is important to keep this in mind in relation to the establishment of any proposed standards by which finished surfaces and surface quality may be measured or specified.

In addition to these combinations of variable operating controls there exists a wide range in maintenance efficiency of similar machines and tools, thus pyramiding the variable factors which influence the generation of surfaces and of surface quality.

III—FUNDAMENTAL PRINCIPLES OF ABRADING ACTUATION

ABRASIVE STRUCTURE

Final surface finish and surface quality are generated on a majority of all parts produced in the metal-working industry by some form of abrading process. These abrading processes use either loose or bonded abrasive under various applications of impact or impulse force and motions.

Every abrading method differs from every other form of shear-cutting method of metal processing because of inherent factors in the abrasive material and the manner in which it is used. Each abrading method differs from all other abrading methods in the manner of force application, the allowable number of simultaneous cutting contacts conventionally employed, the direction of abrasive travel over the work surface, the rate of abrasive and work travel, the amount and uniformity of pressure or force application, and, in some cases, the cutting fluids used.

The honing process uses a large number of fixed or bonded abrasive cutting tips in simultaneous abrading contact, more, in fact, than are usually used in any other abrading method. For

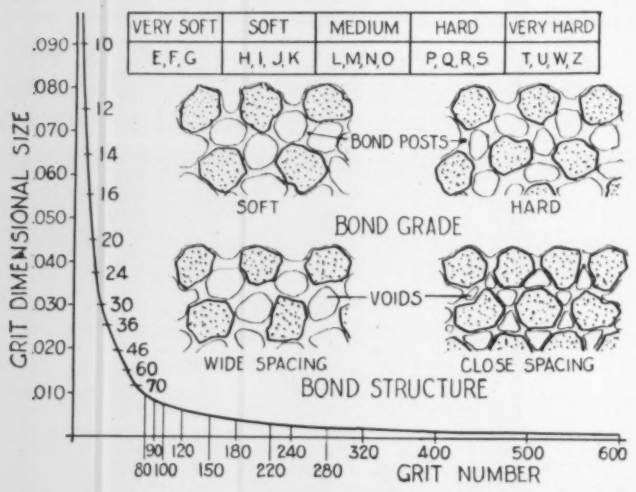


FIG. 1 BOND GRADE AND STRUCTURE

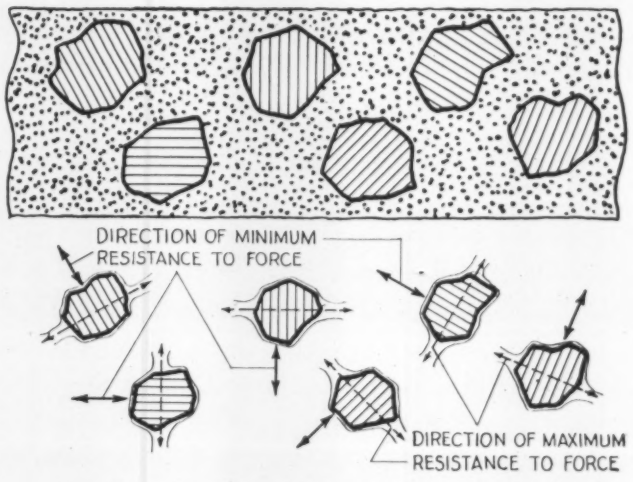


FIG. 2 MULTIPLE DIRECTION OF CLEAVAGE PLANES

example: In a bore 3 in. diam × 8 in. long, size 150-grit stones would have a total area of 7.5 sq in., in which there would be an estimated 98,000-odd simultaneous shearing contacts. A corresponding internal-grinding-wheel application, using a 46-grit wheel, would have approximately 0.055 sq in. of total area in contact with the work, with only about 48 stock-removing contacts at any one time.

Honing stones are made by bonding together in stick form a large number of carefully sized and shaped grains of manufactured silicon carbide or aluminum oxide. Characteristic of all bonded abrasive structures, as shown in Fig. 1, are the one or more vitreous attachments, called "bond posts," of fused quartz which connect each grain to all its neighbors. For harder bonds, a larger quantity of bonding material is used in kiln firing, so that the bond posts are thicker and somewhat greater in number than in softer structures.

These abrasive grains are the hardest materials manufactured in industry. They are rated closest of all materials to the diamond in hardness. Being crystalline, they have definite cleavage planes and are therefore individually friable.

The cleavage planes of individual grits lie at every possible angle to each other in bond. See Fig. 2. The grits fracture most easily when the direction of force application is parallel with their cleavage planes. They are most resistant to fracture when force is applied at right angles to their cleavage planes.

The bond posts, being vitreous, are also friable. In like manner they are more resistant to fracture under compression than under tension.

A bonded-abrasive honing stone, according to its size, may contain from several hundred thousand to millions of individual grains. Each grain has not just one but several sharp points or edges in its boundary contour. All these exposed points or edges are potential cutting tips if properly actuated in motion.

No other type of machining method uses similar friable cutting tips, mounts its cutting tools in friable toolholder mountings, or approximates this point-of-cutting-contact qualification. By this means, some abrading methods accomplish a maximum degree of control in shearing influence when actuated under favorable pressures, speeds, and motions.

FORCE APPLICATION

As in every other type of shearing application, pressure is required to secure and maintain a desired degree of penetration of the grits into the work and motion is required to convert this pressure into a directional force to produce shearing stress. See Fig. 3.

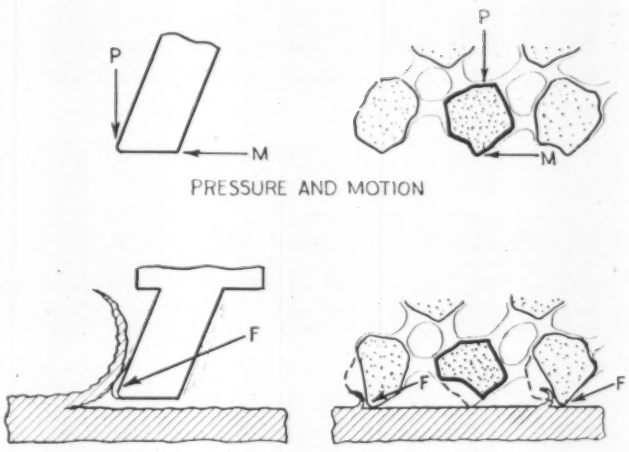


FIG. 3 PRESSURE, MOTION, AND SHEARING FORCE

Therefore, under such actuation, and because of the inherent structural characteristics of the cutting tips in bond, as already described, there is a relatively low limit to the build-up of impulse force which can be applied to the individual grits. This limit depends upon several factors, such as the relative direction of all grit-cleavage planes to the direction of force application, the stress resistance of the bond posts in which each grit is mounted, and the time during which this build-up of force occurs.

It is possible to select and control this limit within close values and thereby confine shearing-stress influence to dimensions of an extremely low order which cannot be registered with any instruments known at present. Then, under favorable abrasive and work actuation, either the abrasive grit or its bond mounting will fracture by the time this limit of force application has been reached.

The total normal pressure conventionally used in honing results in unit pressures which range from approximately 55 to 75 psi in rough-honing and from 40 to 55 psi in finish-honing. These pressures, distributed over thousands of simultaneous cutting-tip contacts, result in unit pressures per grit which range from 0.003 to 0.015 oz in finish-honing and from 0.019 to 0.324 oz in rough-honing. These extremely low pressures are conventionally exerted under the lowest speeds used in any of the mechanical abrading methods.

Shearing-stress influence is thereby localized over a large number of minute area contacts in the work surface and high unit stress is reduced by distributing shearing-force application through a large number of cutter tips. This makes it possible to control the uniform removal of stock in any desired amount at any desired rate from surfaces of any degree of roughness, as shown in Fig. 4. This profilogram represents a rough-bored surface over which a honing tool has been passed for only two strokes. The approximation of the plane-generating action, suggested by the sketch, to the actual profile record of controlled shearing action is readily apparent.

DIRECTION OF MOTION

The direction of motion used in hone abrading is important. It serves to maintain a uniform rate of grit and bond fracture and a uniform number of cutting-tip contacts, and to produce a variety of surface-finish patterns as may be desired. It is directly related to the jumbled relationship of grit-cleavage planes in bond and to bond-post resistance as has already been described.

By the law of averages there are probably as many fully resistant bonded grains as there are grains least resistant to force, and all others will have proportional resistances within this range. Therefore, if an area of bonded abrasive grains is actuated in shear over a surface, maximum cutting efficiency will be obtained only when the direction of abrasive travel is varied frequently, and in an angle wide enough to permit periodic force application parallel with the cleavage planes of all the cutting grains. Frequent change of direction of motion permits the grains and bond posts to fracture in a self-dressing action and thereby maintain sharp cutting edges at all times.

A constant direction of abrasive travel offers a minimum opportunity for self-dressing of the abrasive. Worn or dulled grits are formed very quickly. As such, they are resistant to penetration and tend to ride up over the surface of the metal. This produces a rubbing or burnishing action and a burnished finish.

RATE OF MOTION OR SPEED

One of the most important considerations about rate of motion or speed is the time required for penetration of the grits into the work surface. To a great extent this determines the quality of the work produced as related to depth of shearing-stress influence. To some extent, superficially equivalent results in surface-finish generation may be obtained by widely varying speeds, but they are not equivalent in surface quality.

As a general rule, abrasive travel speed is directly related to the number of simultaneous cutting-tip contacts and to the amount of work which must be done by each of these cutting tips. With but relatively few simultaneous cutting tips at work, harder bonds and very high speeds are required to remove stock under impact-force application. This actuation causes shear fracture by literally blasting stock out of bond and creates extremely high, localized, unit heat and stress. With

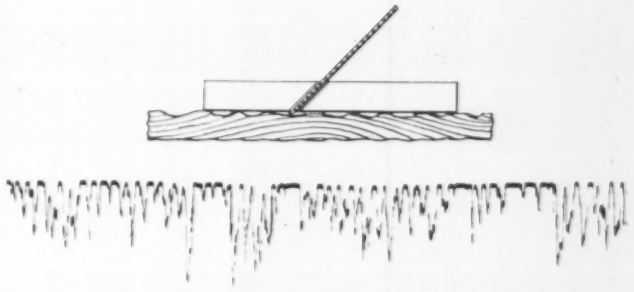


FIG. 4 UNIFORM REMOVAL OF STOCK BY HONING

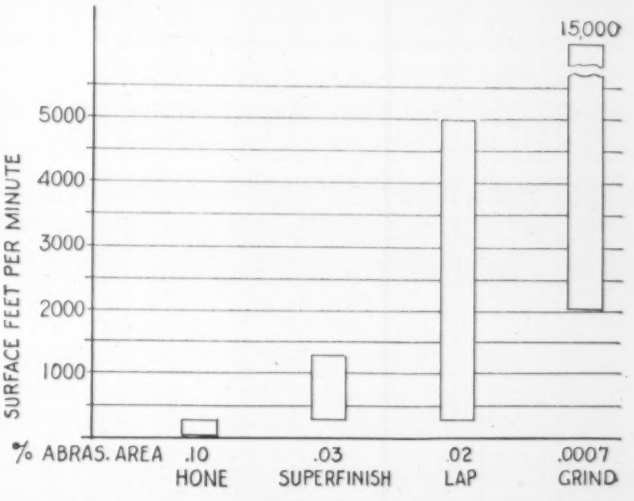


FIG. 5 COMPARISON OF ABRADING AREA CONTACT AND SPEED

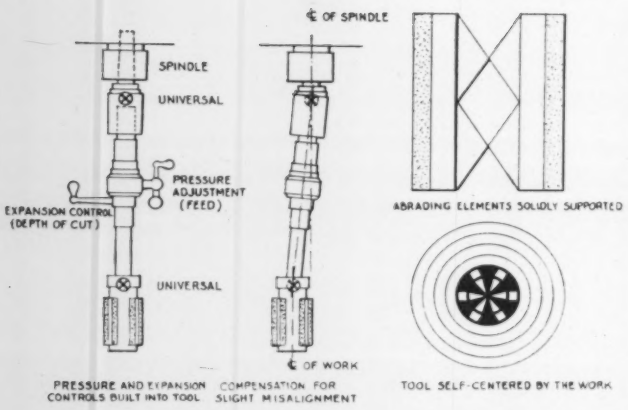


FIG. 6 CHARACTERISTICS OF HONING-TOOL ACTION

Universal joints are conventionally provided in the driver connection with the spindle and between the hone body and its adjusting head. They provide incidental compensation for minor misalignment of the spindle and work, eliminate high spindle-bearing maintenance costs, and allow complete freedom for the hone to center itself with the neutral axis of the bore.

All abrading members are solidly supported by the tool construction and the tool is supported concentrically in the bore by the work itself. This assures balanced shearing-force application and eliminates the possibility of structural deformations due to quill or spindle-bearing limitations.

Because of these features honing tools are not designed to generate concentricity or parallelism of bore axes.

On the other hand, these features do make it possible for a bore which is undersize or which requires additional correctional processing to be rechucked and finished to specified toler-

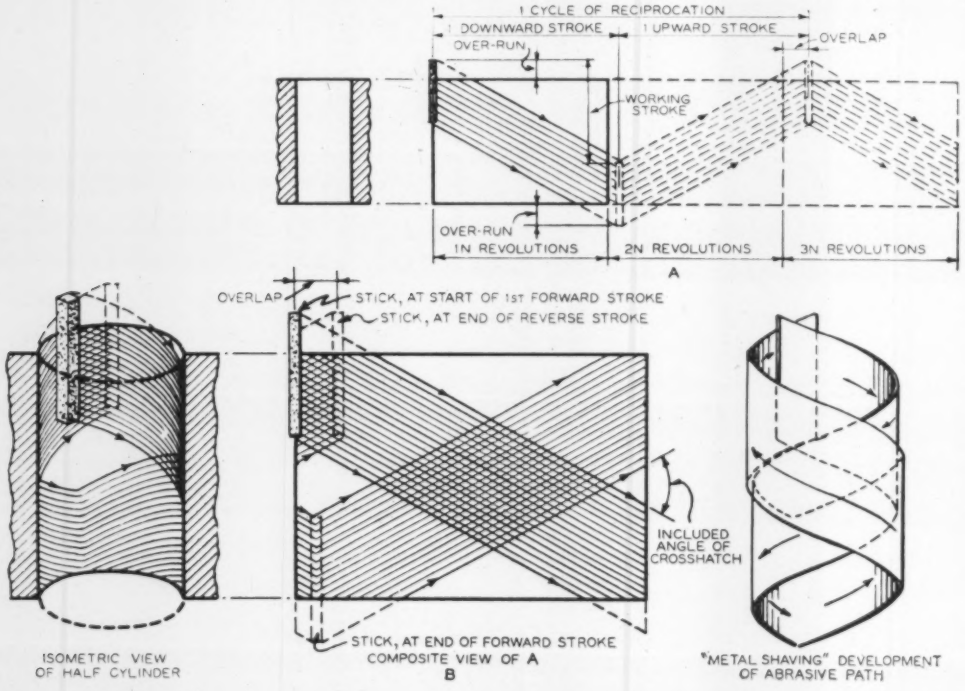


FIG. 8 PATHWAY OF HONING STICK

increased number of simultaneous cutting contacts somewhat softer bonds are used, and speed requirements are preferably reduced to generate impulse-force applications.

As will be noted in Fig. 5, honing conventionally uses the lowest speed of any of the mechanical abrading methods, ranging upward from 10, and rarely exceeding 250, surface feet per minute.

IV—UNIQUE CONTROLS USED IN HONING EQUIPMENT

TOOL CONSTRUCTION

Honing and honing-tool actuation are relatively free from such critical factors of machine balance such as the relative unit weight of assembled machine parts, the machine foundation, inertia factors, vibration, and centrifugal forces.

The entire control of expansion pressure application is designed into the tool adjustment mechanism. See Fig. 6. This assures positive transmission or modification of force and motion in relation to the quantity and to the quality of work desired.

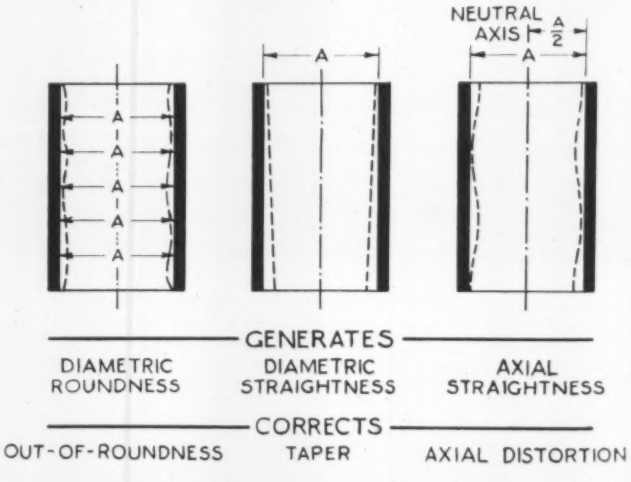


FIG. 7 CORRECTION OF IMPERFECT BORES BY HONING

ances. This is a uniquely important feature in the field of generative mechanical processing.

ACTUATING CONTROLS

Correction of out-of-roundness and generation of roundness are produced by the rotary motion of the hone, and the freedom of the tool to center itself with the neutral axis of the bore. See Fig. 7.

Correction of taper and generation of diametric straightness are controlled by the reciprocation or longitudinal traverse of the tool combined with positive expansion and equalized pressure application throughout the length of the honing stones and the working stroke.

Correction of axial distortion and generation of axial straightness are accomplished by the use of stones long enough to overcome any axial deformity in the bore. Stone lengths are established in relation to bore lengths primarily to assure uniform abrading effort or coverage of the work surface. Through long experience the requirement has been established that the longitudinal travel path generated by opposite ends of the stones at the ends of the stroke shall not overlap in the central section of the bore.

The simplest form of multidirectional abrasive actuation used in conventional honing applications is shown in Fig. 8. It combines simple rotational movement with simultaneous reciprocating strokes or rapidly reversing traverse of the tool. This actuation generates a simple harmonic abrasive travel path. As here illustrated for purposes of simplicity, the ratio is slightly more than two revolutions to one reciprocation.

The path of the stone travel, if thought of as a thin metal shaving, would be as shown in the lower right-hand corner of Fig. 8. The crossing of the paths on the forward and on the reverse strokes forms the symmetrical "crosshatch" surface-finish pattern which is characteristic of this actuation.

It will be noted that the honing sticks are not allowed to return to their original starting position in the bore but are actuated so that they successively overlap their previous positions at the end of each stroke.

The paths of a number of sticks positioned at spaced intervals around the periphery of the hone will cross each other many

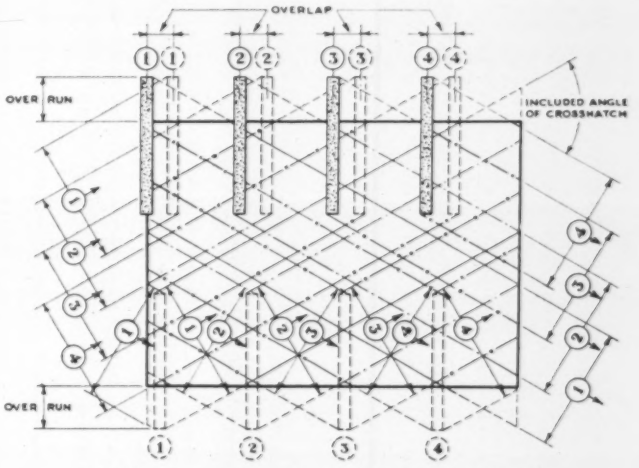


FIG. 9 PATHWAYS OF MULTIPLE HONING STICKS

times during operation, as indicated diagrammatically in Fig. 9. With a wide range of adjustment in establishing the angle of crosshatch in these actuations and with a uniform rate of abrasive fracture, it is virtually impossible for a grit to cut a continuous spiral or to follow in any of its former paths. This is a necessary requirement for uniform abrading effort.

Machining Shell With Carbide Tools

(*Continued from page 860*)

and dovetail forming tools. Steel for sintered-carbide-tipped tool shanks is definitely on the scarce list, particularly steel of nonstandard cross section, which must in consequence be made in many cases from the nearest standard by costly shaping, milling, or grinding. An impartial observer can find little excuse for the multiplicity of shank sizes in use today on the various machine tools used for shellwork. The vital importance of large and especially deep shanks for carbide-tipped tools can hardly be exaggerated. The compressive strength of sintered carbide exceeds that of any known material. It is only necessary to support the cutting tip with as deep a shank as possible to avoid breakage, even on severe intermittent cuts. If the tool shank is large enough to prevent deflection under the cutting pressure, it is practically impossible to crush the carbide tip.

There is no "trick" grind which will give best results on all shell-turning operations, but it is important to make sure that, on subsequent resharpenings, the original tool form, including rakes, clearances, and chip curling grooves, be scrupulously preserved. A fully dimensioned tool drawing should be located at every grinding machine, and before tools are issued for use on the shell line, they should be carefully inspected and any departures from the drawing's specification should be corrected. Negative rake is desirable for a very rough cut because the lip angle of the tool becomes more nearly ninety degrees and the section resisting shear from the cutting forces is proportionately increased. If the conditions, including depth of cut, feed, and concentricity, are such that a positive rake can be used, appreciably more shells per sharpening will be obtained than with a negative rake. For this reason a positive rake is almost invariably used for finish-turning.

The chip-curling groove must be properly shaped and proportioned to dispose of the chip most effectively without adversely affecting the tool life. The carbide-tool suppliers, grinding-wheel manufacturers, and grinding-machine-tool builders have all contributed much valuable published information on the subject of grinding and resharpening tipped tools including the chip-curling groove. Careless and improper grinding can do more than any single form of abuse to reduce the productivity of carbide tools. Careful attention paid to grinding will be amply repaid both in performance and in freedom from tool breakage.

The job to be done by industry can only be achieved by real cooperation among shell forgers, machine-tool builders, toolmakers, grinding-wheel and machine manufacturers, and the users of these materials and equipment. There must be free and unselfish interchange of knowledge, ideas, and experience.

UTILIZATION OF STEAM PASSENGER LOCOMOTIVES

By A. A. RAYMOND

SUPERINTENDENT FUEL AND LOCOMOTIVE PERFORMANCE, NEW YORK CENTRAL SYSTEM

THE increasing daily mileage of the steam passenger locomotive, some of which now operate as much as 20,000 miles a month, is the result of greater reliability and range. Many developments now under way indicate that groups of locomotives are capable and will be increasingly capable of maintaining a still higher average of working time per month. There is no present indication that the limit of utilization of steam power has been reached.

IMPROVEMENTS IN STEAM LOCOMOTIVE RESULTING IN GREATER UTILIZATION

It is axiomatic that greater utilization can be hoped for only if the locomotive gives reliability of performance. The measuring stick of the movement of trains is the on-time performance, the success or failure of which is shown in reports, reaching the mechanical department daily, of delays to trains owing to mechanical difficulties resulting in lost time that could not be made up.

Many improvements have been made in steam locomotives, such as: Decrease in weight per unit of power, one-piece locomotive bed, cylinders and frames cast integrally, refinement in design of various parts, water treatment, roller bearings, refinement in maintenance practice, and feedwater heating. These improvements have increased very materially both the reliability and the capacity of the machine. If time permitted the definite results of each of these items could be discussed but for illustrations the improvements attributable to roller bearings will be considered in detail.

EFFECT OF USING ROLLER BEARINGS

To demonstrate the improvements due to roller bearings, the record is given in Table 1, for 9 years starting in 1927 when all engine trucks were equipped with friction bearings.

About 1929, roller-bearing engine-truck applications were started in substantial numbers, and in 1934 practically all high-speed passenger locomotives had such engine trucks. At that time more than 14,000,000 miles per year were made with no delays chargeable to this cause. During 1940 with better than 19,000,000 miles there were no delays. In the last five years the locomotives made approximately 90,000,000 miles with only two delays which would indicate 45,000,000 miles per delay, whereas, in the first five years of the report, miles per delay averaged approximately 500,000, which means that the roller bearings decreased the liability of delays 90 times.

Fifty eight of the class J or Hudson type (locomotives Nos. 5200 through 5454) locomotives are equipped with roller-bearing driving boxes and 196 of the earlier engines with friction-bearing driving boxes. Over an eight-year period there were 3376 delays with friction-bearing driving boxes, or an average of 47 a year, and with the yearly mileage of approximately 14,000,000 this would mean 297,000 miles per delay. Roller bearings during the same period show no delays on the road, although for the last three years these locomotives have averaged 6,626,150 miles per year.

TABLE 1 AVERAGE MILEAGE PER CUTOUT OF NEW YORK CENTRAL MAIN-LINE PASSENGER LOCOMOTIVES DUE TO HOT ENGINE-TRUCK JOURNALS

BEFORE APPLICATION OF ROLLER BEARINGS ON ENGINE TRUCKS
(Principal type of passenger locomotives in use being the K-2 and K-3)

Year	Miles per delay
1927	373,295
1928	814,469

ALL IMPORTANT PASSENGER LOCOMOTIVES EQUIPPED WITH ROLLER BEARINGS
(Most of the mileage made by the Hudson-type locomotives)

1934	14,486,923 (No delays this year)
1935	15,480,723
1936	15,754,913
1937	17,624,429 (No delays this year)
1938	19,261,201 (No delays this year)
1939	19,379,594
1940	19,780,391 (No delays this year)

In the eight-year period (1933–1940) it is found that on tender trucks the roller bearings made 60 times the mileage of the friction bearings per delay. Trailer trucks with friction bearings, during the same period made 200,000 miles per delay, while with roller bearings there were 5,000,000 locomotive-miles per delay.

Perhaps the confidence the railroad has in roller bearings can best be described by saying that there are 350 locomotives equipped with engine-truck roller bearings, 309 locomotives with tender-truck roller bearings, and a total of 84 locomotives, including all the newer locomotives, with roller bearings on driving boxes, as shown in Table 2.

Another improvement that has a direct bearing on utilization of power is water treatment. Frequently, it was necessary to wash the boiler on arrival but with full water treatment the number of days between washouts has been extended so that the majority of engines can be promptly made ready for service.

With the one-piece cast-steel bed many separate parts and several hundred bolts have been eliminated, all of this contributing further to the reliability of the machine and reducing engine-house maintenance.

THE PROOF OF RELIABILITY

It may be said that all of the foregoing is true, but perhaps it has not been possible to take advantage of these improvements. To explore that possibility, the upper portion of Fig. 1 shows the average miles per serviceable locomotive-day for the last twelve years. This chart covers all of the locomotives of each of the classes handling all main-line traffic, that is, important trains, trains of less importance, and local trains, and providing the necessary reserve locomotives to insure the prompt operation of any extra trains or to meet any condition requiring more locomotives.

It will be observed that the older K-2 locomotives were aver-

Contributed by the Railroad Division and presented at the Semi-Annual Meeting, Kansas City, Mo., June 16–19, 1941, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

TABLE 2 NEW YORK CENTRAL SYSTEM STEAM LOCOMOTIVES EQUIPPED WITH ROLLER BEARINGS

Locomotive number	Number equipped	Engine truck	Drivers	Trailer truck	Tender truck	Piston and cross-head	Rods
2995	1	x	...	...	x	x	...
2996	1	...	...	...	x	...	
2998	1	x	x	...	x	x	
3000–3024	25	x	x	x	x	x	
3025–3049	25	x	...	x	x	x	
4686	1	x	...	...	...	...	
4703, 4704	2	x	...	...	...	...	
4709, 4710	2	x	...	...	...	...	
4733	1	x	...	...	...	...	
4755, 4756	2	x	...	...	...	...	
4905–4914	10	x	...	...	...	...	
4915	1	x	...	x	x	...	
4916	1	x	...	...	...	...	
4917	1	x	...	x	x	...	
4918–4940	23	x	...	...	...	...	
5200–5218	19	x	...	...	x	...	
5219	1	x	x	...	x	...	
5220–5222	3	x	...	...	x	...	
5223–5226	4	x	x	...	x	...	
5227–5233	7	x	...	...	x	...	
5234	1	x	x	...	x	...	
5235–5314	80	x	...	...	x	...	
5316–5342	27	x	...	...	x	...	
5343	1	x	x	...	x	...	
5344	1	x	x	...	x	x	x
5345–5404	60	x	...	...	x	...	...
5405–5449	45	x	x	x	x	x	...
5450–5454	5	x	x	x	x	x	x
Total	351	350	84	102	309	103	6

NOTE: x indicates equipped with roller bearings.

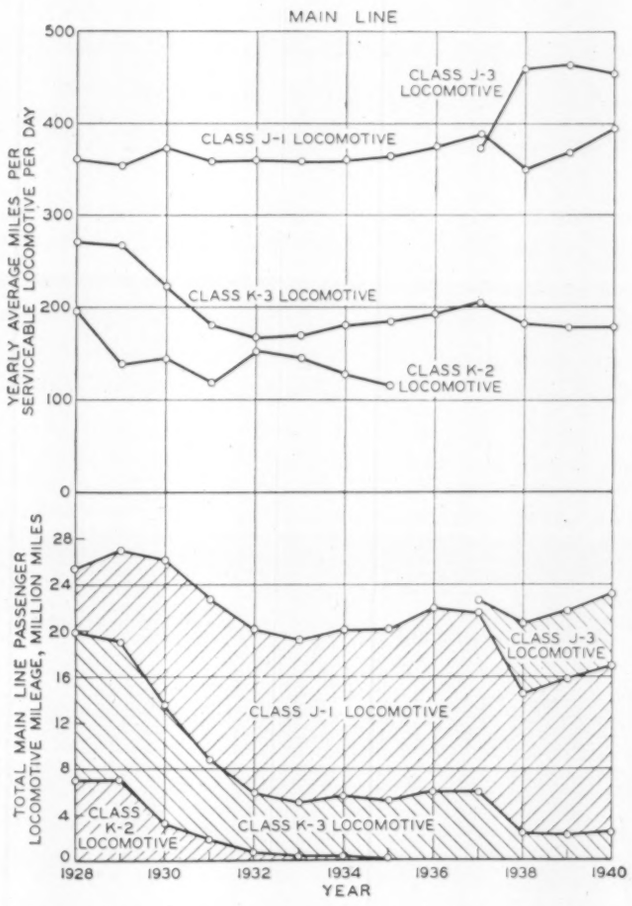


FIG. 1 RELATION BETWEEN AVERAGE MILES PER SERVICEABLE LOCOMOTIVE PER DAY AND TOTAL PASSENGER-LOCOMOTIVE MILES

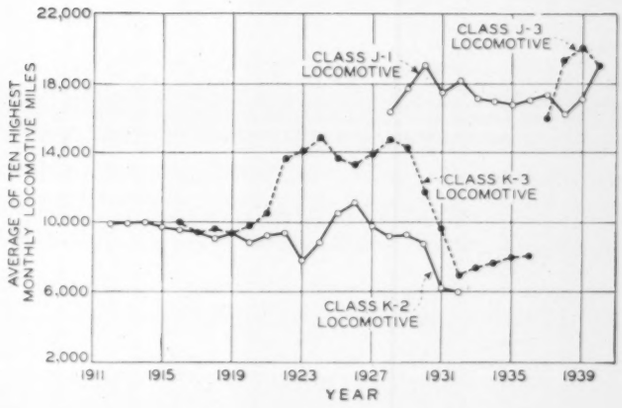


FIG. 2 PERFORMANCE OF TEN LOCOMOTIVES MAKING HIGHEST MONTHLY MILEAGE DURING THE YEAR

aging about 200 miles per day in 1928, but the K-3's were appearing in substantial numbers with an average of 270 miles per day, a material improvement. This average daily mileage for the K-3's continued for about a year. Then the J-1's arriving in substantial numbers immediately began to make 360 miles per day which has been maintained with an improvement in recent years.

It is interesting to note that in 1938 there were a substantial number of the latest class J-3's (Hudson type) and that they almost immediately started making 450 miles a day which has been continued since.

At the bottom of Fig. 1 is shown the total main-line passenger-locomotive mileage made each year. For instance, in the year 1934 it totaled approximately 20,000,000 locomotive-miles, a very small portion of which was handled by the K-2 locomotives, a greater portion by the K-3's, but the largest percentage was handled by the class J-1 Hudson type.

This additional information in the lower part of Fig. 1 is given to illustrate the fact that not only did the newer locomotives individually handle more miles, but the newer type of locomotive also handled increasing percentages of the total business available.

Sometimes it is asked if in former years the locomotives, possibly working on one division, did not, because of being turned back, on a regular train, make higher monthly mileage than locomotives are making now where they run through on many divisions. To answer this question attention is directed to Fig. 2 where the records have been surveyed for the last 28 years and where it is possible to study four classes of passenger locomotives handling main-line traffic.

In making this survey the total mileage made by each locomotive during each month was checked, and the figure illustrates the average miles of the ten locomotives in each class each year which made the greatest total mileage in any one month. For instance, considering the K-2's, one locomotive might make high mileage in June and surveying July we might find two other engines which made high mileage, while in December we might find two more. These would be considered five of the ten engines making the highest mileage in any one month during the year. The high utilization may be made by one locomotive this month and an entirely different locomotive next month.

It is observed that about the year 1920 the highest monthly mileage was under 10,000. At that time a considerable number of the new class K-3 locomotives came into service, and the average miles of the new class became approximately 14,000. Around 1929 the class J-1 locomotives were introduced and immediately began to make mileage in the 18,000-mile range.

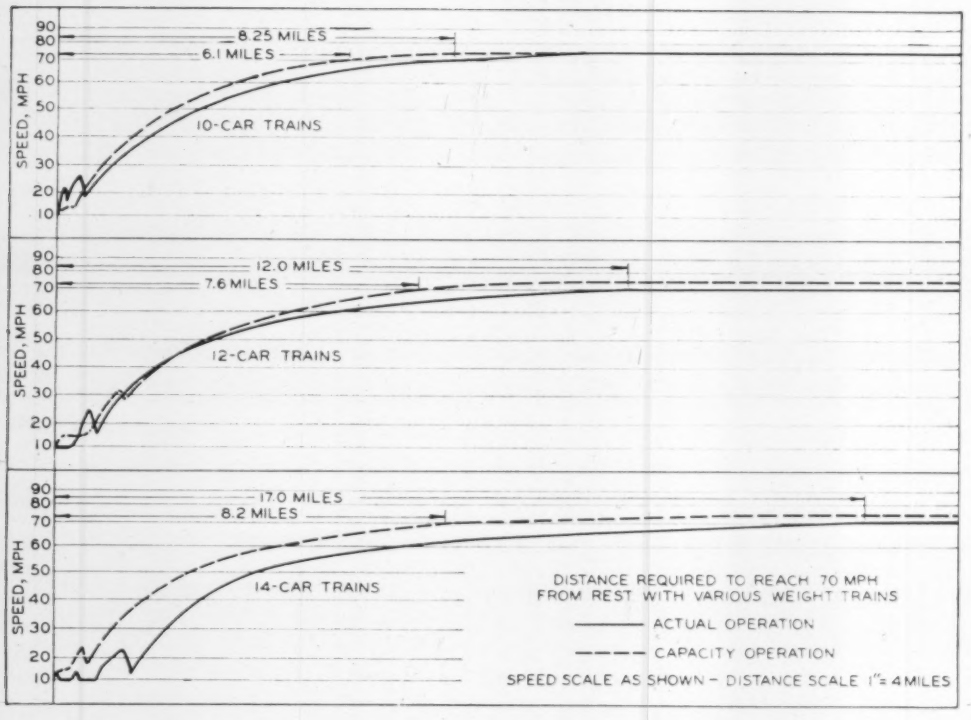


FIG. 3 ACCELERATION RECORDS OF 10-, 12- AND 14-CAR TRAINS

Then in 1938 a fourth class, the J-3, or latest group of Hudson-type locomotives in through passenger service were obtained in a substantial number and began making mileage close to 20,000.

It is interesting to note that when a new improved class of power came into service, it not only started to make a record of its own but suggested ways to improve the performance of the locomotives already in service. The most striking example is the third and fourth classes of power. That is, on the appearance of the fourth class, the mileage of the third class was materially increased until both were fairly close together.

Mileages between classified repairs for all classes and types of steam locomotives on the New York Central Lines, East and West, increased from 75,573 in 1931 and 80,363 in 1937 to 110,213 in 1939, largely because high mileage was obtained from the Hudson type engines. For 37 locomotives of this type shopped for classified repairs in 1937, the average mileage was 221,000. Thirty-one engines exceeded 200,000 miles, and one reached a maximum of 276,761 miles.

HOW FULL UTILIZATION IS INSURED

To insure full utilization of locomotives certain systems have been developed and may be considered under four headings:

1 A survey at each passenger terminal station to see if locomotives can be run through on the same or another train, either in the same or opposite direction, but leaving as soon as possible after arrival of the first train
2 Control figures that will indicate daily for each engine terminal whether there is a surplus of locomotives, which should be stored, or whether there is a shortage of power
3 The operation of a locomotive
4 Provision for necessary coal and water for long high-speed runs.

1—Checking Passenger Stations for Surplus Locomotives

At each passenger terminal station whether large or small a study is made periodically covering a spread of two weeks and all arriving engines and departing trains are charted. As passenger trains run on a regular schedule, this system is found to be practical. Next a schedule is made to use, if possible, the arriving locomotive on a departing train regardless of direction.

2—Checking Engine Houses for Surplus Locomotives

If there are too many locomotives in service, the extra locomotives can only be at the enginehouses, perhaps all at one terminal but more likely at several scattered terminals, so that it is essential to make a check of enginehouse conditions. To do this, the arrival and departure of each locomotive at an enginehouse is charted, and considering the performance of the necessary work at the enginehouse, the expected average turning time at the house is established. The enginehouse in this case can be considered as a store, where profits can be made from goods only if there is a high percentage of turnover of the stock on the shelves. Stock beyond a certain amount is a dead loss; it is a so-called dead stock—not moving—so that above the number of locomotives required at the house (this depends on the reliability of the locomotives continually arriving), any surplus is a loss not only of the approximately $250 per month that it costs to maintain a locomotive ready for service, but also of the fuel represented by the slower movement through the enginehouse (congestion resulting from interference) and of the overhead on the investment in more locomotives than are necessary.

The average turning time at each enginehouse, of course, varies from day to day during the week. The peak traffic ordinarily occurs between Friday and Sunday. On these days there will be a short turning time but the normal figure can readily be established. When the layover time is above the established fair figure the storing of power is started.

3—Obtaining Capacity Performance From the Locomotive

There have been radical changes in locomotives in recent years. Counterbalancing has been improved; where an engine

used to ride hard when working at capacity, it now rides much better. Exhaust tips have been enlarged; where the engine used to "bark" off her exhaust with a loud tone when worked at capacity, the exhaust is now softer. Both of these changes indicate to the engineman that he is not working his engine as hard as he did in previous years. It has become difficult to estimate the capacity at which a locomotive is being used just by listening to the exhaust. When it is necessary to get every pound of available tractive force from a locomotive, experience has demonstrated that it is necessary to give the engineman some indication by which he will know whether he is working the engine at the maximum capacity for the varying speed. To illustrate, reproductions of actual recording tapes are shown in Fig. 3.

These illustrations were made of 10-, 12-, and 14-car trains, and it will be noted from the curves in solid lines that the distance before the train attained full speed of 70 miles an hour was progressively $8\frac{1}{4}$, 12, and 17 miles. The increase in distance might be expected with increasing weights of trains, yet when specific studies were made in the territory it was found that the heavier trains could be accelerated to full speed in 6.1, 7.6, and 8.2 miles.

While acceleration only has been shown, getting over the road in the minimum amount of time is affected also by the rate of deceleration, although in general more time is lost accelerating than decelerating. Fig. 4 shows the time that can be saved by proper braking and accelerating after a slowdown to thirty miles an hour.

It will be noted that decelerating time has been reduced by one half and that accelerating time can be reduced by almost the same amount with the locomotive worked at maximum capacity. Many locomotives will be operated with the minimum loss of time where there is a definite indication for the engineman as to how to operate at maximum capacity.

It may seem that accelerating at maximum capacity is a minor item, but with long runs the number of accelerations necessary because of stops and slowdowns may, upon analysis, be found of such frequency as to make this an important item. On the New York Central, daily checks are made of tapes or charts from locomotives handling some 700 train divisions. It appears that some such definite checks are essential to obtain from a locomotive what has cost thousands of dollars to build into it and many more thousands of dollars to keep in good operating condition. The particular value of these charts is that instead of saying to the engineman "could you have accelerated at an increased rate?" he can be told, "If your speed is 70 mph five miles out, you can save two minutes on the running time." This is more effective than saying, "The train ought to be accelerated more rapidly." It is estimated that it costs a ton of coal to make up a minute by accelerating faster.

The J-3 has greater horsepower than the J-1 and K-3 locomotives and maximum horsepower is produced at higher capacity. This permits faster acceleration and shortens the average cutoff, as running cutoff can be used for a greater percentage of the trip. Acceleration is more rapid at higher speeds and maximum running speeds are more easily maintained. The J-3 can haul more cars on the same schedule than is possible with the older types of locomotives, or it can make better time with the same weight of train, and it seems essential that this accelerating value is obtained.

As the efficiency of the locomotive is improved, it seems almost necessary to study the operation of the different locomotives with a recording tape, thus determining the economical cutoff to use under different running conditions. After a train has reached full running speed the engineman should be encouraged to shorten the cutoff just as much as is practicable in maintaining the schedule. Education in the economical use of the improvements which are built into the locomotive is very essential.

4—Supplying Coal and Water for Long High-Speed Runs

Because of the weight of water required, it is generally impracticable to carry enough water for the long run (Harmon to Chicago). However, some roads, such as the New York Central, have track pans, and experience has shown that adequate tender capacity is about 16,000 gallons.

In general, it is easier to supply water than coal, because water can, where available, be piped conveniently and arrangements can frequently be made to take water at regular stops where crews are changed by having a supply and a standpipe large enough to fill a tender in the three minutes which the train should be standing still. Sometimes the lack of the right kind of water supply makes this difficult and expensive.

TABLE 3 AVERAGE PASSENGER LOCOMOTIVE MILEAGE PER TON OF COAL DISBURSED

NEW YORK CENTRAL MAIN LINE, HARMON–CHICAGO
(All classes of passenger locomotives.)

Year	Average locomotive-miles per ton of coal
1930	19.26
1931	18.85
1932	17.95
1933	18.30
1934	17.73
1935	17.43
1936	16.26
1937	16.12
1938	16.01
1939	15.55
1940	15.14

A study made for the last eleven years, Table 3, of the average passenger-locomotive miles made per ton of coal indicates the

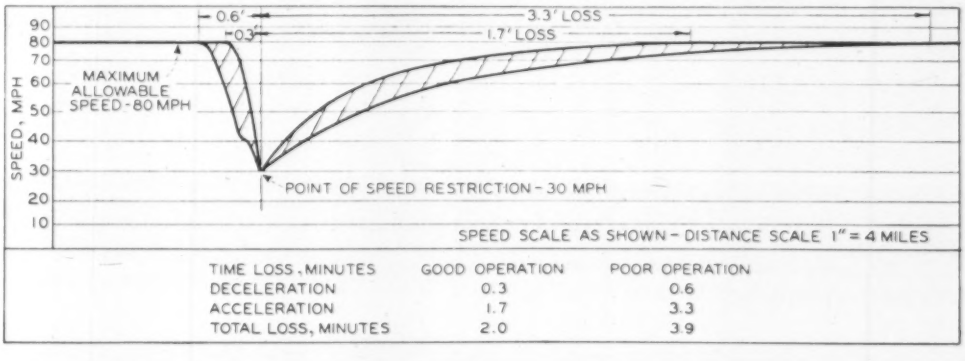


FIG. 4 TIME LOSS DUE TO A LOCAL SPEED RESTRICTION WITH GOOD VS. POOR OPERATION

increasing amount of coal required. These figures include both the coal used in road operation and the coal used at the terminals.

In 1932, when the full fleet of 205 class J-1 locomotives was in service, the scheduled time of important trains was sharply reduced, two hours being cut from the schedule of the 20th Century Limited between New York and Chicago, and proportionate amounts from the time of other main-line trains. In succeeding years, additional reductions were made until in 1935 the schedules of New York–Chicago and New York–St. Louis trains were approximately two hours less than prior to 1932, and the Century schedule was cut to $16^1/_2$ hours, with corresponding reductions on intermediate runs. These reductions in the running time of heavy trains were made possible because of the ample reserve power in the locomotive.

In 1938, the schedule time of the 20th Century Limited was reduced to 16 hours and the schedules of many through main-line trains between New York and Chicago were again shortened, the reductions ranging from 30 min to one hour, with proportionate reductions in schedule time between intermediate points. In 1940, still further improvements were made on some schedules.

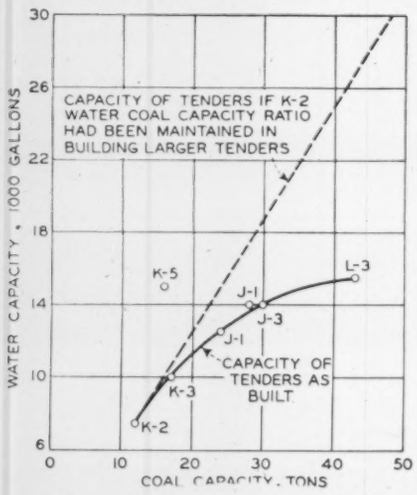


FIG. 5 INCREASE IN CAPACITY, BY LOCOMOTIVE CLASS, OF LOCOMOTIVE TENDERS, NEW YORK CENTRAL SYSTEM, 1907–1940

As a matter of interest, for fifteen system main-line trains, the average schedule reduction from 1926 to 1940 was nearly three hours, representing an increase in average over-all speed of about 8 mph, although in that period the maximum permitted speed had been increased only from 70 to 80 mph.

The introduction of the J-3 class with increased power had a beneficial effect in reducing train-miles by handling more cars per train. On the New York Central Lines, East and West, while the passenger-car miles had decreased, owing to the depression, from 295,022,563 in 1930 to 225,832,083 in 1939, or 23 per cent, the train-miles had decreased 26 per cent, from 31,566,924 to 23,261,971, even though the decrease in passenger business, which accompanied the decrease in all business, has tended to reduce the number of cars in a train. Expressed in other terms, a saving of more than 900,000 train-miles was realized in 1939 as compared with 1930 by increasing the car-miles per train-mile from 9.35 to 9.71.

This will explain the reason for the increasing amount of coal used by main-line passenger power. Summarizing, this increase is the result of heavier trains, faster schedules, air-conditioned equipment, and the like, and indicates what should be considered in determining ways and means of obtaining longer runs between coal stops or cutouts for fuel, for higher utilization. In this connection attention is called to Fig. 5, which shows the coal and water capacities of the locomotive tenders under consideration. To the graph has been added tender proportions of the latest facility, a combination passenger and freight locomotive just recently put in service, the tender of which holds 43 tons of coal.

The solid line in Fig. 5 connects the coal and water capacities of tenders actually in operation, while the broken line shows what the tender capacities would be if the ratio between the coal and water capacities of the original class K-2 locomotive had been continued in the later classes. It will be observed that the tendency is materially to increase the proportionate amount of coal carried. This trend in tender design has resulted from the installation of sufficient track pans with which to maintain service with a tender capacity of about 16,000 gallons. In other words, 16,000 gallons is enough for train operation between track pans.

As will be noted from the foregoing tables and charts, because of faster trains, increased train weight, and air-conditioning equipment, the fuel consumption for passenger locomotives is nearly a ton every 15 miles. Of course, we must realize this figure covers the average for the year, whereas, the consumption is higher in winter and lower in summer. It covers all weights of trains, while more emphasis should probably be placed on the heavier trains which tend to increase the fuel consumption per locomotive-mile. It should be remembered also that the figure includes terminal as well as road fuel. But as a whole, the operation is getting close to 15 road-miles per ton of coal for the principal trains, and it will be appreciated that in arriving at the final terminal there must be some coal left on the tender for emergencies. Considering all these items, it is thought that about 75 tons of coal would be required to insure through movements with heavy trains under all conditions, both winter and summer, from Harmon to Chicago. A locomotive with a tender of this capacity could run from Harmon to Chicago without the necessity of stopping for either water or coal. The only other items to be handled would be the accumulation of ashes, and the disposal of ashes could be arranged in various ways.

SUMMARY

In summarizing the last eleven years it is found that the possibility of passenger locomotives' making high mileage per month has been increased 27 per cent. Reliability of certain parts, such as engine-truck bearings, has been increased 90 times, the coal supply of the locomotive has been increased 2.4 times, and plans are being made to provide more than three times the coal capacity of the locomotives used in 1928.

To obtain greater utilization of passenger locomotives, it is necessary not only to increase the number of hours per day the locomotive is in service on the road, but also to decrease the out-of-service time required either for daily inspection or for reconditioning. The ultimate goal is to have a minimum number of locomotives producing the maximum amount of service.

The increase in utilization is a direct result of the improvements in locomotive construction and maintenance insuring the necessary reliability in service. It seems only proper to suggest some hope for further improvements that are apparently desirable, not only for more efficient operation, but perhaps, of much greater importance, for their influence on the continuation of railroad passenger business. However, it should be realized that the public need for transportation can only be satisfied by the railroads if their speed is greater than that of their competitors.

While the utilization of locomotives is improving, there appears from the records given in this paper to be a definite indication that greater utilization is practical.

A Development in the MANUFACTURE *of* ICE

By B. F. KUBAUGH

HENRY VOGT MACHINE COMPANY, LOUISVILLE, KY.

ORIGINALLY, manufactured ice was produced from raw water in cakes weighing several tons, called "plate" ice, which required cutting into 300- to 400-lb pieces for convenience in handling. This ice was clear and hard, qualities produced by agitation during freezing.

During the same period, clear hard ice was also produced in small cans in masses of 300 to 400 lb from distilled water which required no agitation.

Later by means of the can system the two processes were combined to produce clear hard ice from raw water in relatively small masses. The freezing process, however, was not economical from the refrigeration standpoint, and a wastage of about 6 per cent occurred in freeing the ice from the cans.

In the can system of ice manufacture, it will be understood that as freezing proceeds, the rate of heat flow from the water through the constantly increasing thickness of the forming ice is greatly retarded, the freezing time varying directly as the square of the thickness. In this respect the can system had a great advantage over the original plate system, for example, where 11-in. can ice required 42 hours for freezing, 11-in. plate ice required 168 hours, due to the fact that the latter was frozen from one side only.

DETAILS OF TUBE-ICE MACHINE

In order to overcome the drawbacks and limitations of these former systems, a new method of producing hard clear ice at once in small pieces of almost any desired size has been developed in the form of a tube-ice machine, which will be described. This machine has been designed to combine all the desirable features of the two earlier systems, including a crushing operation after the ice is formed.

Referring to Fig. 1 the tube-ice machine consists of a number of tubes of any diameter or length set on end vertically and enclosed in a shell, much in the manner of the well-known vertical tubular open-ended condenser, commonly called the "shell-and-tube" condenser. Such a vessel is suitably supported over an inclined chute, consisting partly of solid metal and partly of screen or perforated metal.

Below the chute is a water tank from which the water to be frozen is withdrawn by a pump and delivered to the top of the vessel where it is distributed evenly to the several tubes. Each tube is provided with a metal distributor, Fig. 2, which causes the water passing through its orifice to be projected against the inner surface of the tube to which it clings in its descent. This circulation of the water provides the agitation (actually a washing action) which is required to produce clear ice.

Beneath the vessel and above the chute, is a rotating cutter, Fig. 4, which not only nicks and breaks the ice as it descends, but also measures the length of the protruding pieces.

Beneath the lower tube head (refer to Fig. 3) is situated at a very short distance a shear plate which is attached to the tube plate by a ring, thus forming a closed chamber comprising an auxiliary thawing chamber through which a very small quantity of moderately warm water (85 to 90 F) is discharged at the desired moment to thaw the bottom tube head. This shear plate also relieves the tube head of any shock due to the cutting operation; the cutter lies just beneath the shear plate.

The tubes protrude only a short distance below the tube head and are extended to and through the shear plate by means of copper ferrules, thus forming the thawing chamber referred to.

The vessel itself is filled with the refrigerant (usually ammonia) to the required height, determined by a float-controlled liquid feed valve situated at the proper level. Near the top of the vessel is situated a horizontal transfer drum into which the refrigerant from the freezer is periodically discharged and from which it is expelled and returned to the freezer. An accumulator or liquid trap is attached to the transfer drum.

FREEZING OPERATIONS

At the beginning of the freezing operation a timing mechanism which controls all of the functions is started. On single-vessel installations, the timer also controls the water pump, starting and stopping it periodically. On multiple-vessel installations the water pump runs continuously and the timer merely controls the admission of the water alternately to the two or more vessels comprising the unit. With the water in circulation, the timer opens the suction valve and the liquid feed, and the freezing process proceeds for a period predetermined for the suction or evaporating pressure employed, and for the thickness or kind of ice desired.

At the termination of the freezing period the timer shuts off the suction gas, the liquid feed, and the water flow, then admits high-pressure evacuating gas from the condenser, which displaces or removes the liquid refrigerant from the freezer into the transfer drum, and at the same time thaws the ice from the tubes. A few seconds after the beginning of the evacuation, the timer starts the rotating cutter, and admits warm water to the thawing chamber. Simultaneously with the removal of the liquid, the ice in the tubes drops by gravity onto the rotating cutter and is delivered to the chute in pieces of the desired size.

All of the events described take place in a matter of seconds; the entire operation from the moment when the suction valve is closed to the moment when the last piece of ice has dropped onto the chute occupies hardly more than two minutes regardless of the size of the freezing vessel. A slightly longer period, however, is allotted to cover any irregularities.

The water which is circulated and which drops from the tubes returns to the pumping tank through the perforated portion of the chute. The ice, discharged, passes over the perforated portion to other points of delivery, such as a chute (to a storage room below) or to a horizontal conveyer or an elevating conveyer.

The thickness of the ice from a very thin shell to a solid

Contributed by the Process Industries Division and presented at the Fall Meeting, Louisville, Ky., October 12–15, 1941, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

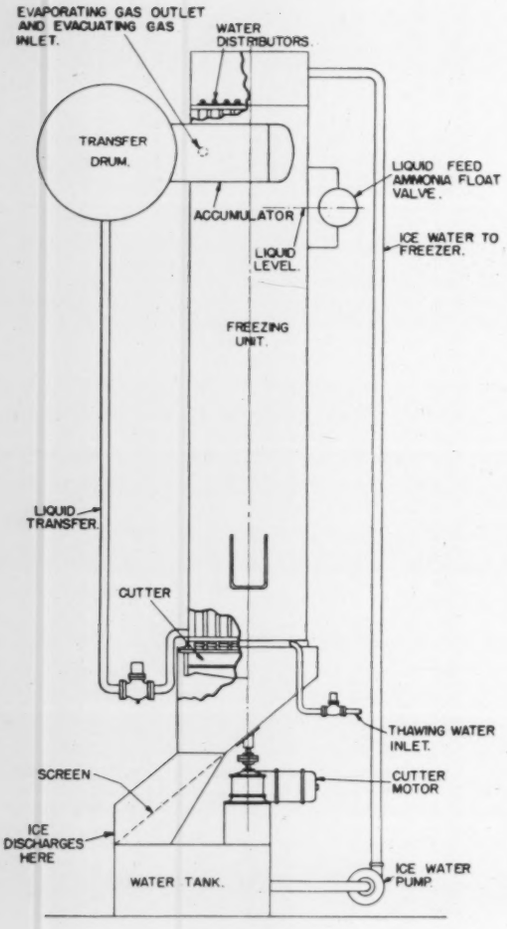


FIG. 1 AUTOMATIC TUBE-ICE MACHINE

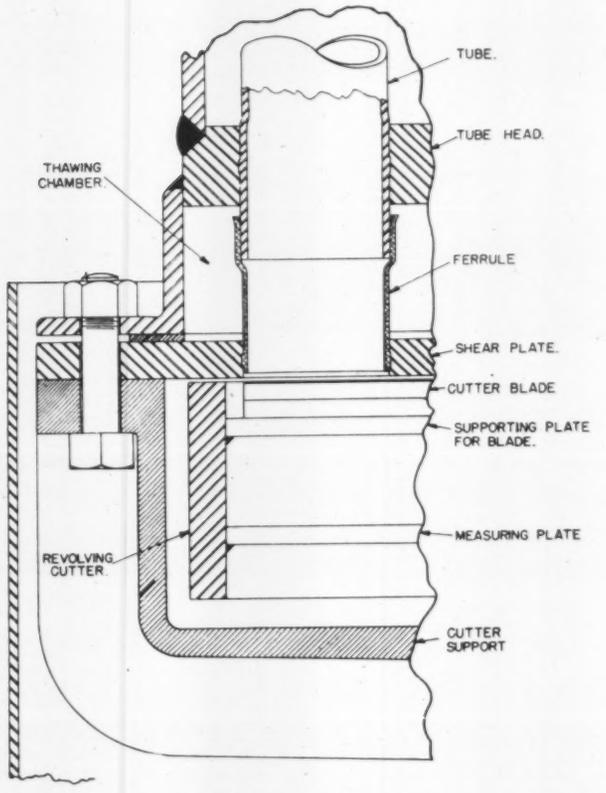


FIG. 3 SECTION THROUGH LOWER PART OF MACHINE, SHOWING SHEAR PLATE, AUXILIARY THAWING CHAMBER, REVOLVING CUTTER

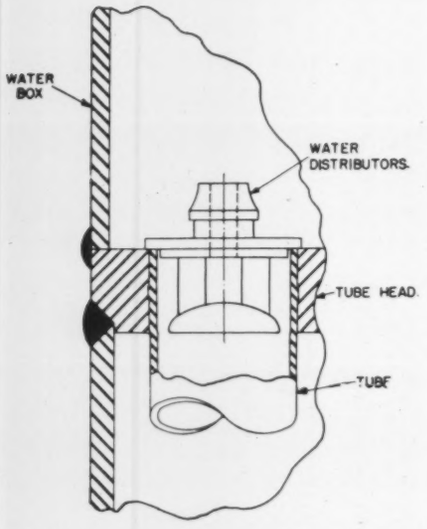


FIG. 2 DISTRIBUTOR PROVIDED WITH EACH TUBE

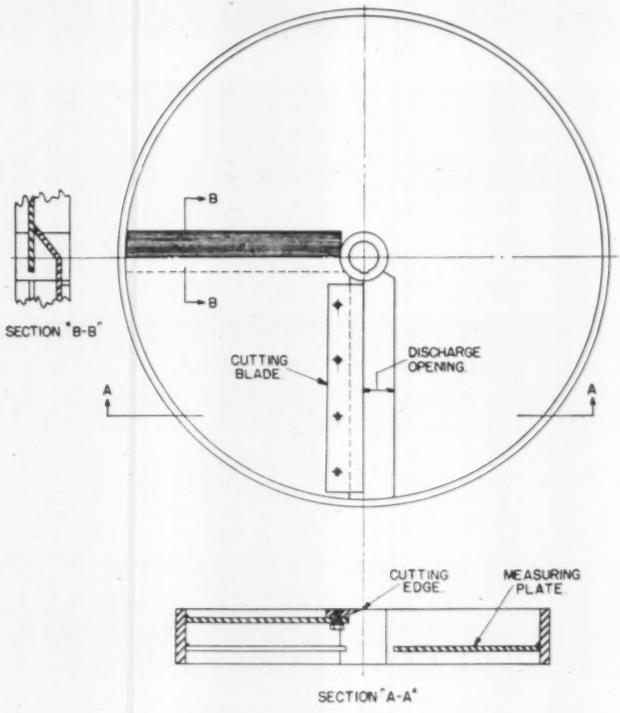


FIG. 4 DETAILS OF ROTATING CUTTER

cylinder is controlled by the length of the freezing period which in turn is regulated by a simple speed control on the small timer motor.

The freezing period varies from as little as 10 minutes for shell (crushed) ice at low evaporating pressure (around 15 lb gage) to about 37 minutes for solid ice at high evaporating pressure (around 30 lb).

Where crushed ice is desired the ice cylinders are relatively

thin (about $\frac{1}{2}$ in.), and short, so that the cutter, which for such a purpose has a rather blunt edge, breaks them up into small pieces.

The question will be asked, no doubt: "What effect has the freezing of the solid ice on the tubes?" The answer is that there is no discernible effect. The tubes are not expanded by the freezing action because the water is not confined in any manner. Analogous to this is the freezing of ice in the conventional can which produces no distortion of the can. The solid ice produced as a standard is a cylinder approximately $1\frac{3}{4}$ in. diam and $2\frac{1}{2}$ in. long. Other lengths may be furnished by merely fixing the measuring plate of the cutter at the required distance. In fact, an adjustable cutter is available, whereby the length can be altered from time to time, requiring only a few minutes for the purpose.

DETERMINING THE FREEZING CAPACITY

The number of freezing vessels required in any given case is determined by the capacity desired, the maximum diameter of freezer advisable, the evaporating pressure, and the kind of ice (solid or crushed) preferred; also, by the maximum number of vessels deemed desirable. All capacities up to that of the largest single freezer require, obviously, only one vessel. As indicating the flexibility of the tube-ice system, single freezer units cover capacities from a fraction of 1 ton to 29 tons in "solid ice" and to 40 tons in crushed ice.

When the required quantity of ice exceeds the capacity of a single maximum-diameter freezer, then the number and diameter of freezers is determined from the freezing period selected and the harvesting or cutting period. Such consideration leads to the adoption, for large capacities, say of 150 to 200 tons of the system wherein evacuation takes place from shell to shell rather than from shell to transfer drum, which has structural and cost advantages unnecessary to enlarge upon in this paper.

The timing mechanism consists of several cams of plastic material mounted on a horizontal shaft driven by a very small motor. Each cam controls a small electrical switch which opens or closes a circuit to operate a magnet-controlled valve, one for each function of the system, viz., liquid feeding, freezing, evacuating (and thawing), and final thawing. Cutting and water circulation are also so controlled through proper devices.

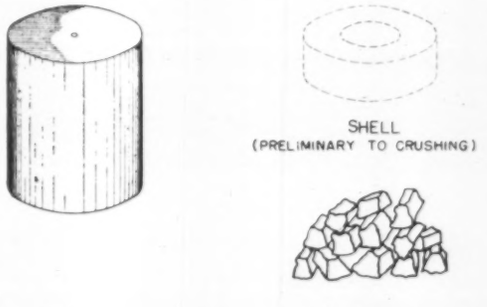


FIG. 5 SOLID AND HOLLOW ICE CYLINDERS

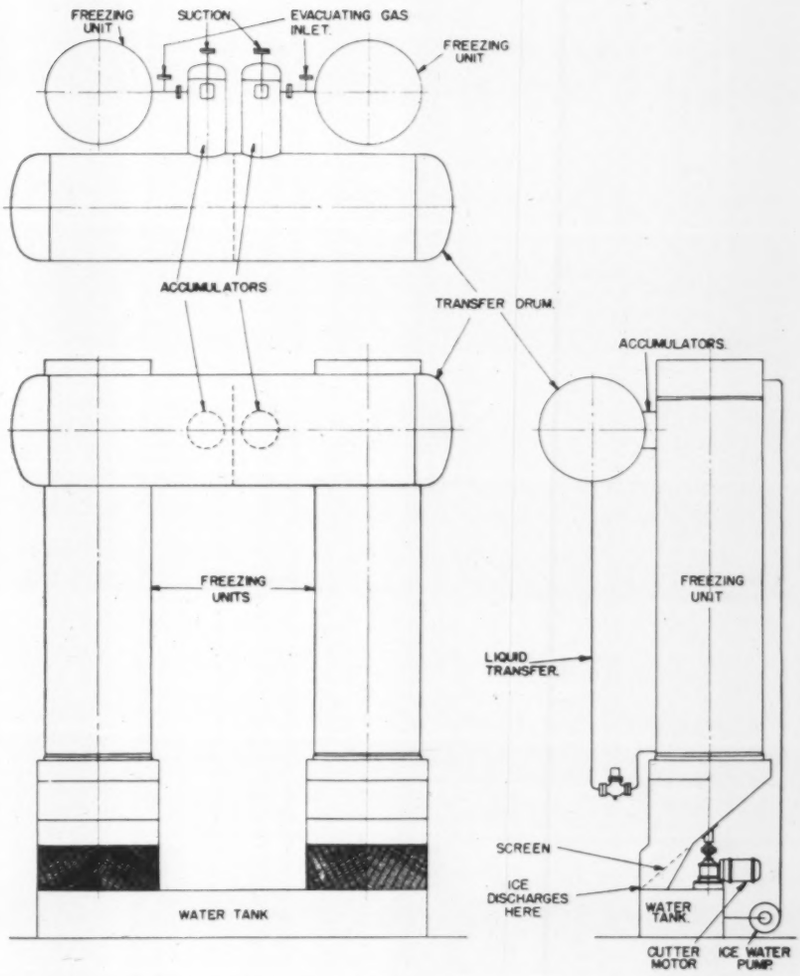


FIG. 6 AUTOMATIC TUBE-ICE MACHINE, SHOWING SHELL-TO-TRANSFER-DRUM EVACUATING SYSTEM

The motor on the timer is so connected that it may be accelerated or reduced in speed to control the freezing period only; all other functions proceed at a previously fixed speed. Each function is indicated by a small colored light on the control panel, making observation extremely easy. The control panel also mounts a pressure gage and magnetic starters for the cutter motor and water pump, as well as small selector switches dubbed into the timer circuits, by means of which any function may be operated manually at will, if desired or necessary. Magnetic starters for other purposes, such as the conveyers previously described, may also be mounted and operated simultaneously with the cutting operation.

Fig. 8 illustrates a complete freezing unit in section showing the operations described.

Fig. 5 illustrates several ice cylinders, both solid and hollow. There is no fixed length for the "solid ice," which can be made to suit any peculiar conditions or preferences. The hollow cylinder is the form best suited to the production of crushed ice.

REFRIGERATION AND POWER REQUIREMENTS

Regarding refrigeration and power required to produce 1 ton of tube ice, it is evident that the weight of metal, heated and subsequently cooled in the evacuating and thawing operations, is quite large in proportion to the ice made, but it should be understood that such heating constitutes merely a transfer of

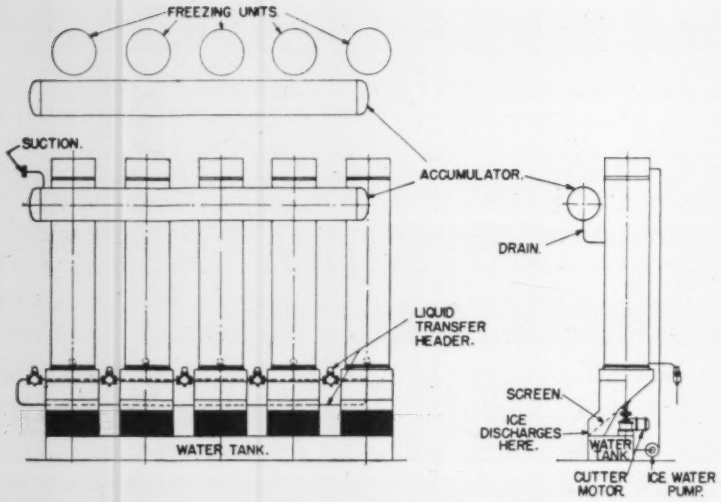


FIG. 7 AUTOMATIC TUBE-ICE MACHINE, SHOWING SHELL-TO-SHELL EVACUATING SYSTEM

heat from one part of the system to another, This also produces changes in temperature and state of the (ammonia) gas used for evacuating and thawing, as well as changes in temperature only of the small quantity of water used for thawing, whereby some of the evacuating gas is condensed and the thawing water enters the system at a temperature lower than that of the water from the original source.

Consideration of these factors shows that the refrigerating capacity is lower than that required in the conventional can plant, where 6 per cent of the ice frozen is washed away to the sewer, about 25 per cent lost in sawing (cubes), and where the heat of compression of the low-pressure air used for agitation must be absorbed by the refrigerating machine.

In the tube-ice system, which incidentally is entirely automatic involving only occasional supervision, nothing leaves the apparatus but the ice to be used. All small particles which chip off in the cutting process return to the pumping tank, contributing refrigerating effect to the circulating water.

The tube-ice machine may be attached to an existing refrigerating plant or it may be installed independently with its own "high side," compressor, condenser, receiver, etc.

The space occupied may prove interesting. A 10-ton single-vessel freezing unit occupies a space approximately 6 × 7 ft; a 40-ton single-vessel unit, 8 × 9 ft; a 65-ton two-vessel unit, 8 × 12 ft; a 200-ton five-vessel unit, 9 × 30 ft or 18 × 20 ft. Figs. 6 and 7 illustrate some of the arrangements of multiple-vessel units.

USES FOR TUBE ICE

Tube ice has many uses and the apparatus may serve the dual purpose of cooling water only during a part of the day and freezing ice during the remainder by merely setting the suction valve to produce the required evaporating temperature for either purpose, or arranging two valves in parallel lines, each set for its respective pressure with proper stop valves for bringing each into service. This feature is especially desirable in dairies for providing cold water for processing the milk, cream, butter, etc., during the working day, and providing the solid ice during the remaining period for local delivery of the same items.

"Solid" ice is also adapted to car icing, and to chemical processes which require temperature control, combined with a minimum dilution. It may also be used successfully in household refrigerators of the type dependent upon icing, by providing suitable means (open- or woven-wire containers and the like) for proper handling. Crushed ice is suitable for the shipment of vegetables, fish, etc., by placing it in direct contact with such products. Crushed and solid ice are suitable also for direct immersion in beverages; the solid form, being novel in this respect, should attract attention.

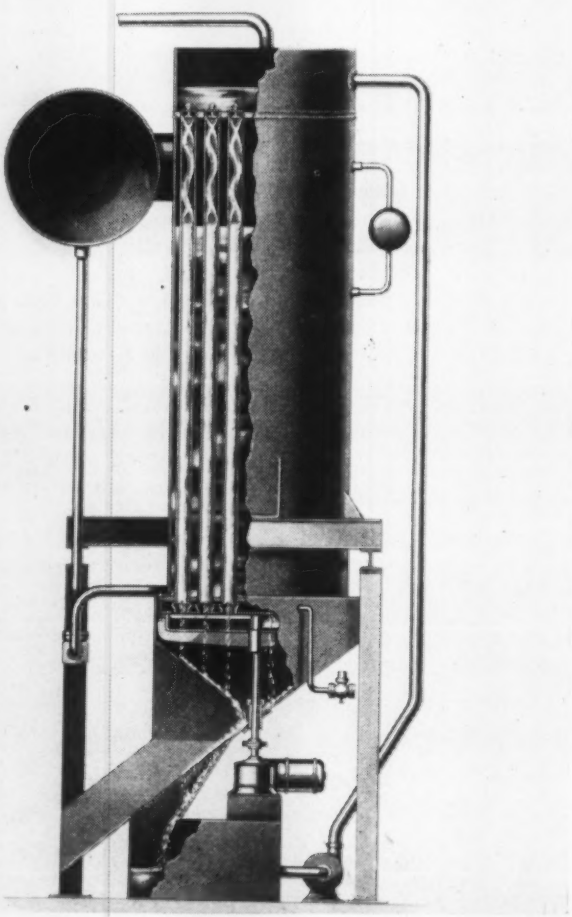


FIG. 8 SECTION THROUGH COMPLETE

Progress in RAILWAY MECHANICAL ENGINEERING, 1940-1941

GENERAL CONSIDERATIONS

IN OFFERING this "Progress Report," the Survey Committee wishes to call attention to the fact that of necessity it is not a "calendar-year" or even a meeting-to-meeting report, but rather represents the period from about September first to September first; even this is only possible owing to the leniency of the Program Committee in giving a few weeks of grace past the normal submission date.

EQUIPMENT DEMAND CREATED BY NATIONAL DEFENSE PROGRAM

It is rather difficult to find terminology in which any sort of succinct characterization of this arbitrarily chosen 12-month period may be expressed. A great acceleration in orders and construction has resulted from the increasing tempo of the National Defense movement. The period of large production of railway equipment does not necessarily correspond to the period of engineering progress, however; it is well known that some of the greatest advances in our art have come during the doldrums as far as volume of construction was concerned. The present condition of large orders and high-pressure construction has been accompanied by some very significant improvements. Some of these relate directly to the general business condition, while some would more naturally characterize times of "slow" business, and actually grow out of studies conducted at leisure during the late unlamented depression.

Certainly the outstanding general trend in railway operation is that most appropriate to the National Defense Program gradually getting into full stride—the move toward increasing the efficiency and capacity of freight service. This move has already been noted in these progress reports.

Some important phases of this process may be mentioned as of most direct concern to the mechanical engineer: Suitable freight cars, primarily boxcars, are needed for high-speed service and high mileages, a considerable number of which are already being actually handled regularly in passenger trains. Improved trucks and draft gear are especially demanded, and reduced tare weight has become of greater importance than ever. In one lot of cars, which are making record mileage at high speed, roller bearings are contributing to the simplification of the maintenance problem. From the locomotive standpoint, improved counterbalancing, high-capacity tenders to reduce service stops, and the assignment of high-driver locomotives (even 80-in. wheels) to freight service, are the factors which are extending "next morning delivery" and "hot-shot service." The engineering department is contributing improved track maintenance and centralized train control through congested areas as a means of reducing dispatching delays.

EQUIPMENT AND PERFORMANCE STATISTICS

Certain facts from the Annual Statistical Review of the *Railway Age* bear closely on the subject of this report: The total number of cars on line fell off from 2,238,000 in 1928, to 1,610,000 in 1939, and this figure was maintained in 1940. The total number of active cars reached its minimum, in 1934, of 1,294,000 and has steadily increased since that time, the 1940 figure being 1,404,000. Fifty thousand new cars were placed in service during 1940, and an equal number were retired. The total number of locomotives in service at the end of 1940 was 40,355, of which 27,461 or 68.5 per cent were installed previous to 1920, and have thus "come of age." This "of age" group accounted for 57 per cent five years ago. Increasing intensity of utilization is reflected by a constant increase in the ratio of "gross ton-miles per train-mile," which has increased from 1584 in 1923 to 2120 in 1940, and in "locomotive miles per active locomotive," which rose from 2600 to 3224 in the period from 1923 to 1940. Average train speed has increased more than 50 per cent during the period. As many as 8985 locomotives were "stored serviceable" in 1933, and 1493 in 1940. Estimates of maximum traffic for 1941 indicate that the margin of available locomotive power has become too narrow for safety, or in the neighborhood of 4 per cent. The number of internal-combustion locomotives has continued to increase; at the end of 1940, there were 1023 switching and transfer engines and 159 road locomotives in service or on order.

Performance records, during the year 1941, follow (figures are for the first 10 months) and attention is called to new records:

Freight-train speed, 16.7 mph (equals record)
Gross ton-miles per train-hour, 33,856 (record)
Freight fuel per thousand gross ton-miles 111 (record)

Costs of coal and fuel oil (less freight) remained substantially stationary. Representative equipment costs are to be found in Table 1.

TABLE 1 REPRESENTATIVE EQUIPMENT COSTS

Steam locomotives (based on weight of locomotive only, in working order):	
Simple 2-8-8-4	31¢ per lb
Simple 4-6-6-4	31¢ per lb
4-8-4	37¢ per lb
2-10-4	30.4¢ per lb
0-8-0	30¢ per lb
Diesel-electric, 2000-hp passenger	57¢ per lb, $88 per hp
Diesel-electric, 660-hp switcher	31¢ per lb, $95 per hp
Freight cars:	
50-ton hopper	$2095 to $2619
70-ton covered hopper	$3603 to $3770
40-ton box, wood-lined	$2455
40-ton box, all-steel	$2036
50-ton box, all-steel	$2734 to $3380
50-ton auto-furn	$3660 to $4847
50-ton all-steel	$2635 to $4840
50-ton box, steel-sheathed	$2876 to $3939
Passenger-train cars:	
83-ft chair car, 52 seats	$68,000
83-ft lunch diner, 38 seats	$87,000
80-ft chair obs, 60 seats	$84,000
84-ft mail baggage	$54,000
84-ft obs-parlor diner, 41 seats	$95,000
85-ft coach, 74 seats	$70,000

ORDERS FOR EQUIPMENT

During the year 1940, a total of 65,817 freight cars were ordered in this country and Canada, as compared with 121,220

Report of Committee RR6, Survey, contributed by the Railroad Division for presentation at the Annual Meeting, New York, N. Y., December 1–5, 1941, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Report prepared by the Chairman, E. G. Young, with cooperation of members of the Committee, Messrs. B. S. Cain and K. F. Nystrom.

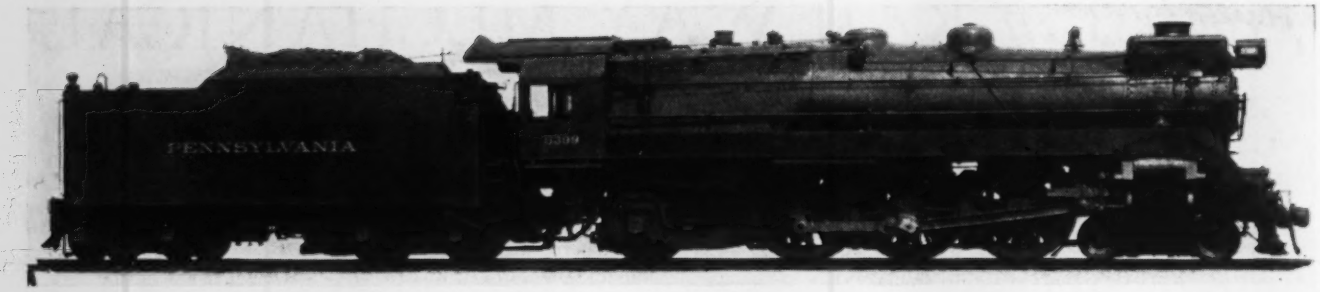


FIG. 1 PENNSYLVANIA RAILROAD K-4 PACIFIC WITH FRANKLIN STEAM DISTRIBUTION

ordered in 1929. Locomotive orders during the year 1940 totaled 697, as compared with 1306 in 1929. Of the 1940 orders, 222 were steam, 462 Diesel-electric, and 13 electric locomotives, making an 86 per cent greater total than during the previous year. Among the steam-locomotive orders (December, 1940) was one for 15 of the new 4-8-8-4 wheel arrangement, with four simple cylinders, and one of 2 engines of the 4-4-4-4 type, only previously used in the B.&O. experimental all 4-cylinder nonarticulated type.

A third new type is represented by 10 locomotives of the 2-6-6-6 arrangement. Other types ordered include:

4-6-6-4-38	2-8-2-6
2-8-8-4-8	2-8-4-7
4-8-2-60	2-10-4-5
4-8-4-36	

Six railroads ordered Diesel-electric road freight engines. The increasing application of light Diesel-electric locomotives

TABLE 2 EQUIPMENT ORDERS BY MONTHS, SEPTEMBER, 1940, TO AUGUST, 1941

	Locomotives					
	Diesel-electric			Steam		
Month, 1940	Road	Switching	Electric	No.	Type	Freight cars
September	..	40	..	2	4-8-2	9470
				10	2-6-6-6	
October	..	23	..	7	2-8-4	11786
November	..	13	..	1	0-6-0	9026
				2	0-8-0	
				13	4-8-4	
				6	4-6-6-4	
December	..	63	..	15	4-8-8-4	7319
1941						
January	..	49	5	20	4-6-6-4	14118
February	3	75	5	4	2-8-2	
				8	4-6-4	
				25	4-8-4	
				7	Switching	5645
March	9	53	1	40	4-8-8-2	7685
				10	4-8-4	
				6	2-8-8-2	
April	8	59	..	1	0-8-0	16091
May	8	63	..	20	4-6-6-4	19221
				1	4-8-2	
June	12	78	15	15	4-8-2	29299
				15	2-8-4	
				10	4-8-4	
				15	2-8-8-0	
July	7	92	..	23	4-6-6-4	10889
				24	2-8-4	
				21	4-8-4	
				10	2-8-8-2	
				1	Switching	
August	23	91	(a)	14	2-8-4	4679
				16	2-8-8-2	
				6	4-8-4	

[a] Two steam-turbine locomotives ordered.

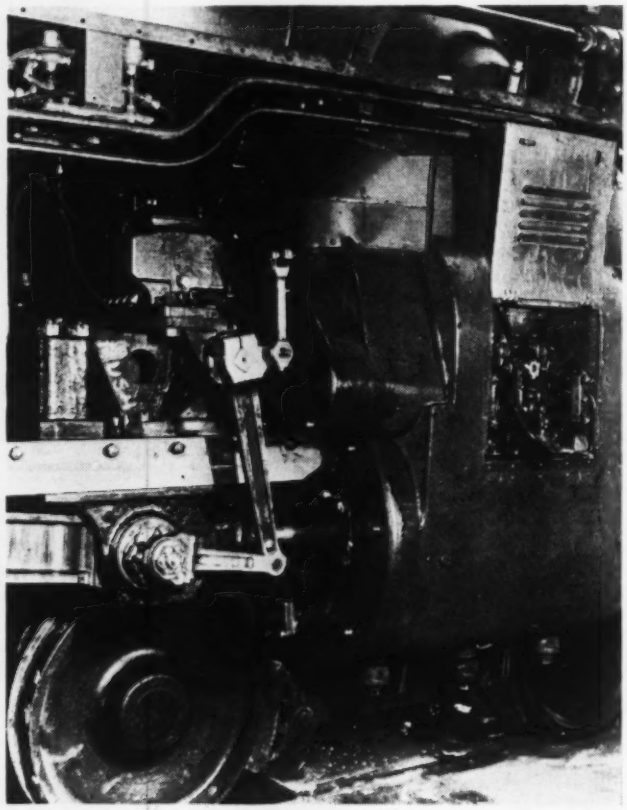


FIG. 2 K-4 WITH POPPET VALVES: VALVE-GEAR ROCKERSHAFT AND CROSSHEAD CONNECTION

(End of cam bed seen in opening in cylinder jacket.)

of about 90,000 lb weight and 300 to 400 hp is very noticeable.

United States and Canadian passenger-car orders were 349, or 11 per cent below last year. Only about 10 of these cars were what might be called standard-weight equipment, running up to about 170,000 lb for a diner-lounge car; the remainder were for special-named trains—either their initial equipment, or general refurnishing of trains already in service.

Equipment orders for the period of September, 1940, to August, 1941, are summarized in Table 2.

A.A.R. MECHANICAL DIVISION MEETING

Of the reports presented at the annual meeting of the Mechanical Division of the Association of American Railways, those of the committees on car construction and the development and use of oil-electric locomotives are of outstanding interest. The Car Design Committee reports that, in cooperation with the American Railway Car Institute, progress is being made on the design of standard lightweight steel-sheathed

boxcars and on lightweight 50-ton and 70-ton hopper cars. Arrangements have also been made with the same group to prepare designs for a standard steel-sheathed boxcar and an automobile car of 50 tons' nominal capacity, with carbon-steel riveted construction. The inside dimensions are to be 50 ft 6 in. × 10 ft 6 in. The automobile cars will have staggered side doors with a 15-ft clear opening.

A tabulation was presented of 55,500 house-and-hopper-type cars recently built, showing that substantially 90 per cent of these were either entirely of A.A.R. design or corresponded to the principal elements thereof, differing only as specific conditions required; less than 1 per cent definitely did not correspond to A.A.R. standards.

The committee has under consideration a new type of tubular car axle. Approval has been withheld pending fatigue tests on full-sized specimens. As a result of the tests conducted, it was demonstrated that the tubular axle with reduced weight provided materially greater fatigue strength and increased loading capacity. The design presented was recommended by the committee for letter-ballot approval for all interchange purposes, with the reservation that this approval did not cover the tubular axle in general but merely elements of the design.

The Oil-Electric Locomotive Committee reported that 1111 units have been installed since 1925, one third of these having been put into service in 1940. These were classified by horsepower as follows:

Horsepower	No.
Less than 300	26
300–600	191
600–900	522
900	90
950–2000	199
2000 and over	93

During 1940, the number of oil-electric locomotives in switching service increased from 676 to 973, representing a decrease from 90.5 to 87.5 per cent of the total number of units in service; units in road freight service increased from 4 to 20 and in passenger service from 69 to 118. A report of repair costs per mile, eliminating those units which were held out for general repairs during the test period, indicated averages rising progressively from about seven cents per mile for 600-hp road engines to twenty cents per mile for 4000-hp engines.

The test of a boiler with welded longitudinal seams has been in progress since September, 1937. The annual inspection for its third year of service was made in June, 1940, and all conditions were satisfactory. No leak or simmer from these seams has ever developed. A report of the 1941 inspection was not available at the time of the meeting of the Mechanical Division.

New checking formulas for rods were proposed to take the place of those of 1914.

A.S.M.E. (RAILROAD DIVISION) JUNE MEETING

At the Kansas City Meeting of The American Society of Mechanical Engineers, on June 17, 1941, one of the extremely valuable papers presented (that of Mr. Pond of the Norfolk & Western) made a comparison between the performance characteristics of old and new motive power. Some of the many significant figures adduced are the handling of 10 per cent more freight ton-miles with 47 per cent less locomotives (which figure exactly corresponds to the increased average tractive force of the locomotives in use, and to the gross ton-miles per train-hour); a decrease of 39 per cent in the coal consumption per gross ton-mile; a decrease of 32 per cent in the repair cost per million tractive force-pound-miles, to a figure of 45 cents per engine-mile for the average locomotive in use.

AMERICAN STEAM LOCOMOTIVES

Table 3 gives the principal dimensions of a number of locomotives built or modernized for domestic service.

Item 1 represents the well-known K-4 class of the Pennsylvania Railroad. The disclosure of the results of laboratory and road tests of this locomotive, equipped with the Franklin (oscillating-cam poppet-valve) system of steam distribution, is an outstanding event of the current year. In road tests, the locomotive, which has two 27-in. × 28-in. cylinders, 205 psi working pressure, and 80-in. drivers, developed a maximum horsepower of 2980 at 60–65 mph. Compared with the results of the A.A.R. passenger-train tests, previously reported in this series of papers, the gain in drawbar horsepower was 24 per cent at 60 mph, 33 per cent at 70 mph, and 44 per cent at 80 mph. With a 1000-ton train on level track, the poppet-valve engine attained 88 mph, and the original engine 78.5 mph. In general, the road tests showed the capability of the poppet-valve locomotive to meet the fastest schedules on the fast Fort

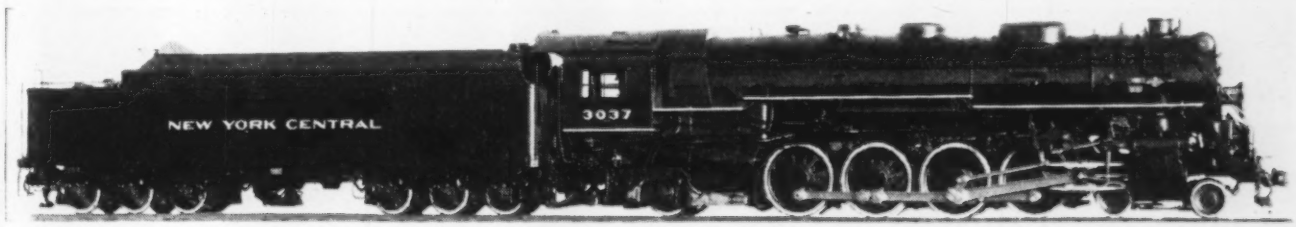


FIG. 3 NEW YORK CENTRAL 4-8-4 LOCOMOTIVE REDESIGNED FOR PASSENGER SERVICE

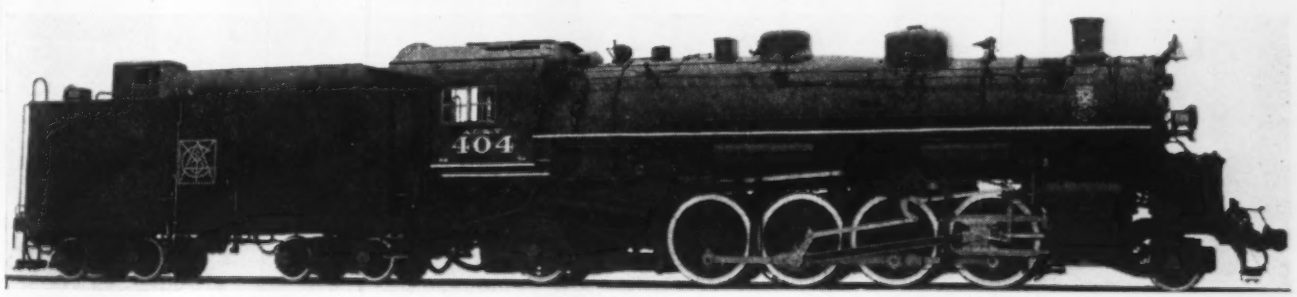


FIG. 4 AKRON, CANTON, AND YOUNGSTOWN 2-8-2

TABLE 3 DOMESTIC STEAM LOCOMOTIVES

Item No.	Type	Railway	Builder	Cylinders: No.	Cylinders: Diam and stroke, in.	Cylinders: Diam of drivers, in.	Boiler: Working pressure, psi	Boiler: Evaporative heating surface, sq ft	Boiler: Superheating surface, sq ft	Boiler: Grate surface, sq ft	Weights (1000's), lb: On drivers	Weights (1000's), lb: Total engine	Weights (1000's), lb: Tender	Rated tractive force, lb	Tender capacity: Fuel, tons	Tender capacity: Water, gal
1	K4S 4-6-2	Penn.	Ry., Lima	2	27 × 28	80	205	3686	1277	70	208.8	330.8	176	44400	..	...
2	4-8-2	N.Y.C.	A.L.Co.	2	25½ × 30	69	255	4657	2080	75.3	262	388.5	302.2	60100	43.5	15500
3	4-6-2	Erie	B.L.W.	2	27 × 28	79	210	3718	1315	70.8	205	331	314	46100	24	16500
4	2-8-4	W.&L.E.	A.L.Co.	2	25 × 34	69	245	4718	1924	90.3	265	415	289	64100	22	22000
5	2-8-2	A.C.&Y.	Lima	2	26 × 30	64	200	3507	972	66.7	227.5	319.7	176.7	53800	16	12400
6	4-6-2	Alaska	B.L.W.	2	22 × 28	72	200	2660	846	625	156	250	160	36500	14	10000
7	2-8-8-4	D.M.&N.	B.L.W.	4	28 × 32	63	240	6782	2770	125	560	695	437	140000	26	25000
8	4-6-6-4	W.M.	B.L.W.	4	22 × 32	69	250	5770	1735	119	402	601	338	95500	30	22000
9	2-8-2	D.T.&I.	Lima	2	23 × 30	63	260	4009	1815	67	248.5	369.5	194.2	55600	18	143000
10	4-8-4	B.&M.	B.L.W.	2	28 × 31	73	240	4511	1887	79	26	415	320	67000	21	23000

Wayne-Chicago Division with trains of 13 cars. On the test plant, the locomotive developed a maximum indicated horsepower of 4267 at 75 mph and 4100 at 100 mph. With a steam consumption of 70,000 lb, the engine used about one seventh less steam per indicated horsepower at moderate speeds, and the improvement in economy increased to more than 30 per cent at 100 mph.

While most of this improvement was attributable to the valve gear, it should also be noted that, as tested in the laboratory, the locomotive was provided with an improved superheater arrangement and increased steam-passage areas, so that the minimum area between boiler and cylinder is 70.9 sq in. instead of the former 45.5 sq in. The figure for the highest net evaporation was 77,000 lb at 100 mph. The minimum steam rate for the poppet-valve engine was 15 lb per ihp, secured at 360 rpm. At 423 rpm (100 mph), the steam rate ranged from 17.1 to 18.6 lb per hp, with a range of 22 to 35 per cent virtual cutoff. The machine efficiency varied from 85 to 95.6 per cent, the maximum being obtained at 56.8 mph and 49 per cent virtual cutoff. The locomotive is illustrated in Figs. 1 and 2, and the principal dimensions appear as item 1 of Table 3.

Item 3 of Table 3 represents a class of 4-6-2 passenger engines,

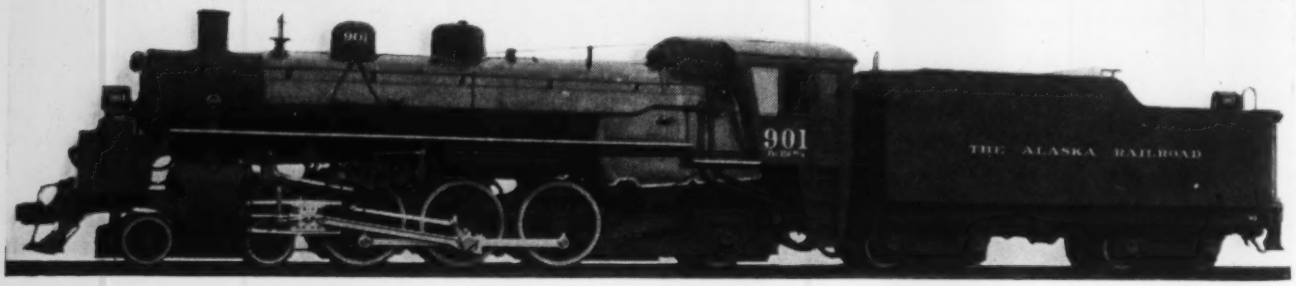


FIG. 5 4-6-2 FOR ALASKA RAILROAD

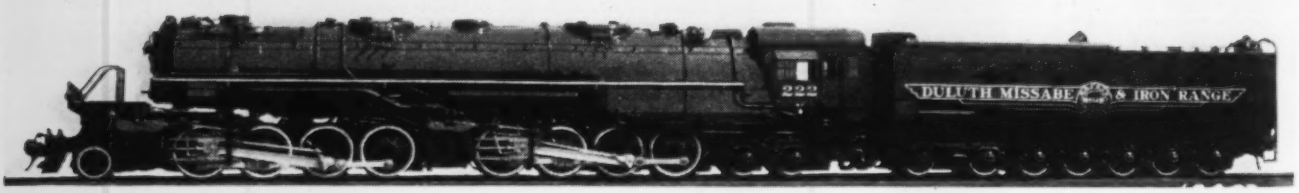


FIG. 6 2-8-8-4 FOR DULUTH, MISSABE & IRON RANGE

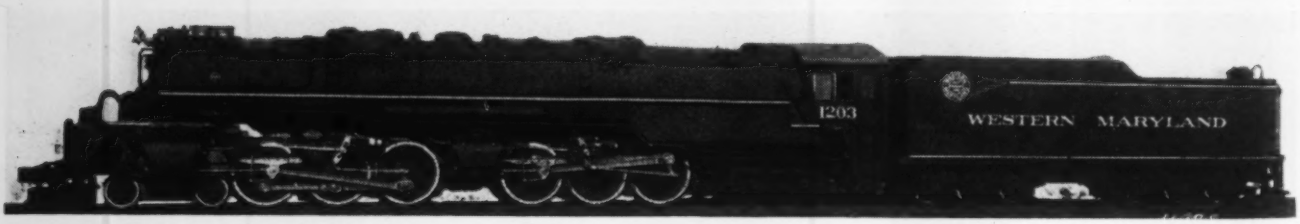


FIG. 7 4-6-6-4 FOR WESTERN MARYLAND

FIG. 8 4-8-2 FOR BOSTON & MAINE

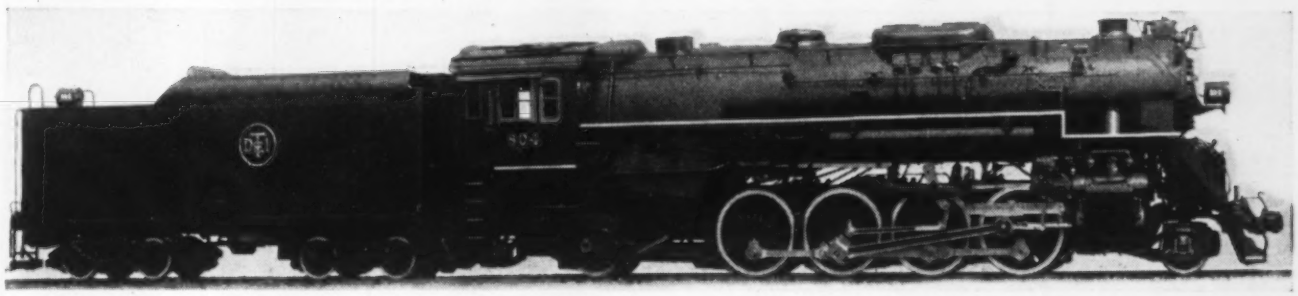


FIG. 9 2-8-4 FOR DETROIT, TOLEDO & IRONTON

originally built by the Baldwin Works in 1923, which have recently been through the company shops for rebuilding. The original dimensions and ratios have been retained, but the following notable improvements have been incorporated: Cast-steel engine beds, replacing the original frames; multiple guide suspended from the guide bearers only (not connected to the back cylinder heads); and boosters with 12,000 lb tractive force. These engines are assigned to 739-mile runs from Jersey City to Marion, Ohio.

Item 2 of Table 3 represents the new group of 4-8-2 locomotives for the New York Central. The design of these locomotives, shown in Fig. 3, and designated as class L-3, resulted from the conversion of two locomotives of the L-2 class into passenger engines by increasing the boiler pressure, lightweight reciprocating parts, dynamic balancing, complete or partial installation of roller journal bearings, and other devices rendering them suitable for service at higher speeds. Road tests of one of these locomotives proved it capable of operation at speeds up to 87 mph (423 rpm) with no effects on the track more serious than those imposed by the 4-6-4 engines with 79-in. drivers. Following the changes made, the L-3 class was purchased, the wheel arrangement and diameters of the previous engines being retained, which has resulted in locomotives embodying the general characteristics of fast-freight power but which are suitably equipped and fully capable of being put into passenger service in case regularly assigned engines are inadequate in number or power for emergency requirements. The redesigned L-3's weigh about 15,000 lb more than the L-2 class. These engines are fitted with the longest tenders which can be turned on a 100-ft table, permitting the record coal capacity of 43 tons.

Item 4 of Table 3 is an identical reorder of a type first built in 1937. Item 5 is a moderate-weight Lima-built 2-8-2. The general similarity which it bears to the "heavy Mikado" of the U.S.R.A., Fig. 4, should be noted.

Item 6 is a Pacific for the Alaska Railway, the first locomotive ordered for this line in several years, Fig. 5. The engine is equipped with a stoker, vestibuled cab, and snow flangers. A weight of 52,000 lb per driving axle indicates improved standards of track maintenance.

TABLE 4 FOREIGN STEAM LOCOMOTIVES

Item No.	Type	Railway	Builder	No.	Cylinders: Diam and stroke, in.	Cylinders: Diam of drivers, in.	Boiler: Water heating surface, sq ft	Boiler: Superheating surface, sq ft	Boiler: Working pressure, psi	Boiler: Grate area, sq ft	Weights (1000's), lb: On drivers	Weights (1000's), lb: Total engine	Weights (1000's), lb: Tender	Tender capacity: Rated tractive force, lb	Tender capacity: Coal, tons	Tender capacity: Water, gal
1	2-6-2	L.&N.E.	Ry.	3	15 × 26	68	1444	336	250	28.5	108	157	96	27200	6.7	4200
2	4-6-2	Sou (GB)	Ry.	3	18 × 24	74	2451	822	280	48.5	141	207	112	37500	5.6	6670
3	4-6-2	German State Ry.	Borsig	2	22½ × 26	79	2174	753	227	44	116	224	...	...	..	...
4	2-8-0	Victoria Govt.	Ry.	2	20 × 26	54	1447	281	175	26	121	140	96.2	28700	5.5	5100
5	4-8-2- 2-8-4 Garratt	Bengal-Nagpur	Beyer Peacock	4	20½ × 26	56	3453	661	210	70	...	516	...	70000	11	...
6	4-10-2	Sorocabana (Brazil)	A.L.Co.	3	17½ × 22 × 24	48	3346	851	235	65.3	187	250	110	44600	11	4500
7	4-6-2	N.W. (Ind.)	Vulcan	2	18½ × 26	67	1762	442	210	38	104	189	138	25500	11	5300
8	4-8-2	M.Z.&A. (Spain)	T.&M.	2	22 × 28	69	2215	1249	295	54	159	256	168	49100	11	10000
9	4-4-2	G.I.P. (India)	N.B.&Ry.	2	20½ × 26	78	1599	382	180	32	84	161	102	21433	2.2	1600
10	4-8-4	Victoria Govt.	Ry.	3	21½ × 28	66	3980	800	220	72	214	329	255	55000	..	...

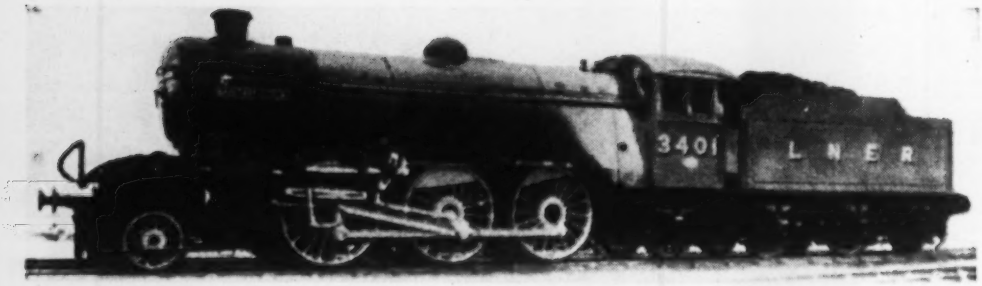


FIG. 10 2-6-2 FOR LONDON & NORTHEASTERN

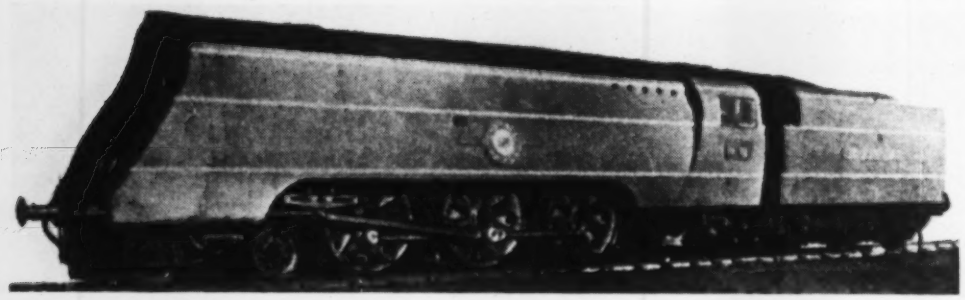


FIG. 11 SOUTHERN RAILWAY (BRITISH) 4-6-2 "MERCHANT NAVY"

FIG. 12 4-6-2 FOR GERMAN STATE RAILWAYS

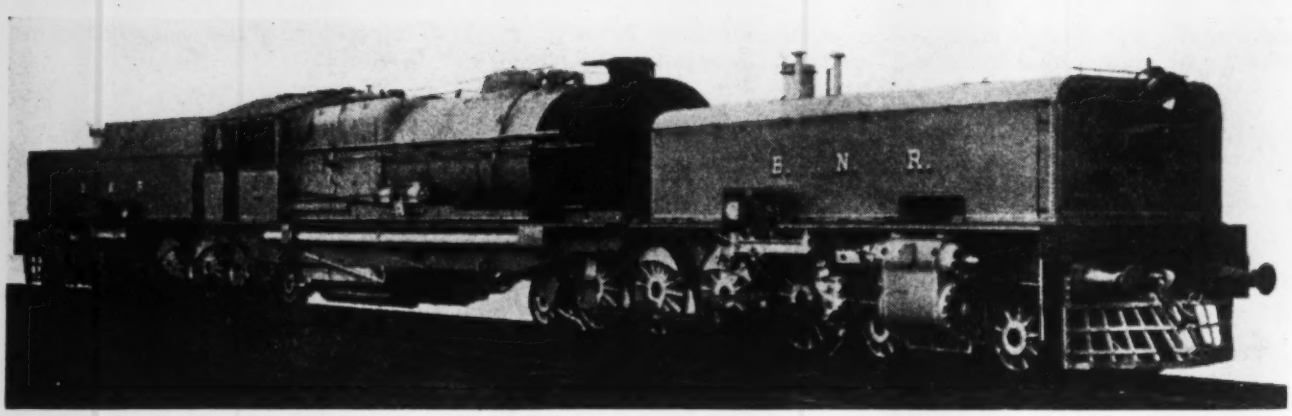


FIG. 13 GARRATT TYPE FOR BENGAL-NAGPUR

Item 7 is a Baldwin simple articulated type for the Duluth Missabe and Iron Range, which has dimensions and weights approaching the maximum recorded. This engine, Fig. 6, has a tender fitted with the recent General Steel Castings tender bed, having one swiveling truck and five pairs of fixed pedestals.

Item 8 is another representative of a popular class, the 4-6-6-4 articulated, for the Western Maryland, Fig. 7.

Item 10, Fig. 8, is a reorder of high-wheel freight engines, this group also having the General Steel Castings tender-bed casting.

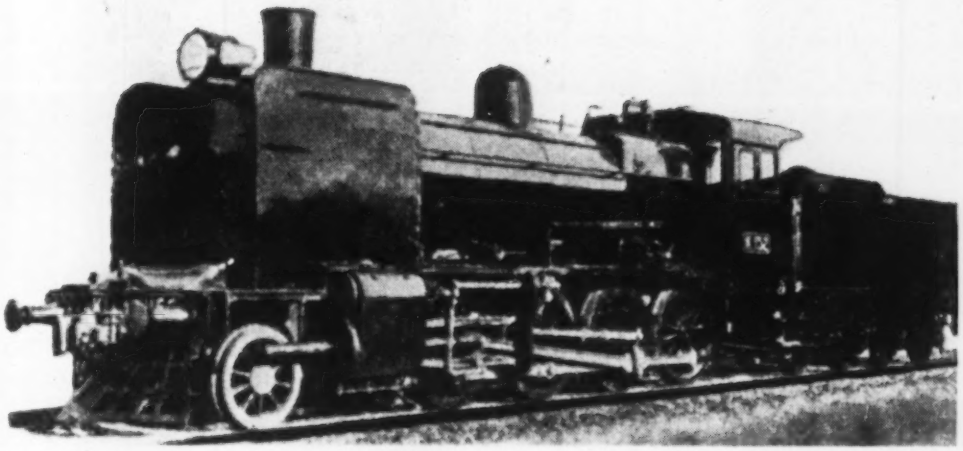


FIG. 14 VICTORIAN RAILWAY 2-8-0

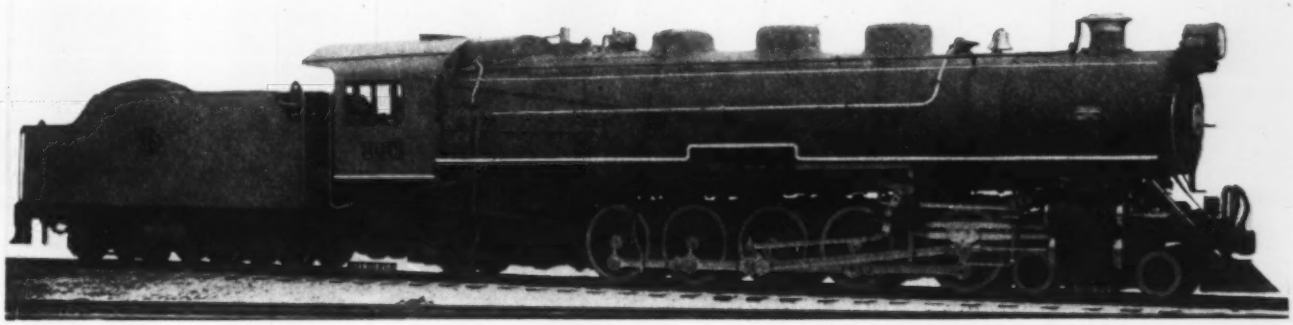


FIG. 15 SOROCABANA 4-10-2

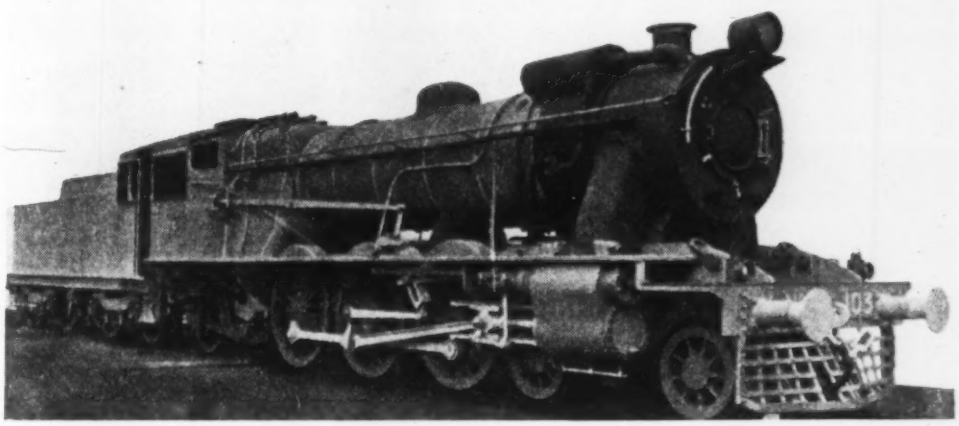


FIG. 16 INDIAN RAILWAYS BOARD INTERMEDIATE 4-6-2

FOREIGN STEAM LOCOMOTIVES

Table 4 gives principal data for a group of foreign steam locomotives with some item of unusual interest connected with each. The L.&N.E. Railway has a well-standardized class of heavy 2-6-2's (*Lord President* class) giving notable results but unable to move over a considerable mileage of branch-line railway acquired in the "railway grouping" of five years ago. To meet the need for modern power of weight light enough to cover the greater part of the mileage, a lighter 2-6-2 is being built (Fig. 10, and item 1 of Table 4). The three-cylinder type persists in England; also note item 2; new passenger Pacifics for the Southern, characterized by "air-smoothing" (Fig. 11) in British terminology, and driving wheels of a form familiar to us but new in England. The castings are obviously designed to look as much like the spoked driving center as possible. Item 3, illustrated in Fig. 12, is the 15,000th locomotive built by the Borsig Locomotive Works of Berlin and placed on the State Railways with appropriate commemorative ceremony. The photograph would scarcely be informative to the most expert locomotive fan, but adequate data came through the British press.

Item 5 calls attention to the continued adherence of the

British colonial railways to the Garratt type locomotive. The locomotive illustrated in Fig. 13 represents an order of four placed in service on an Indian railway (66-in. gage) with a maximum axle load of 17 long tons (38,000 lb). These engines haul loads of 2000 tons up 1 per cent grades and around 10-deg uncompensated curves. They are about equivalent to an American design booster-Mikado engine with 28 × 30-in. cylinders.

The Victorian (Australia) 2-8-0, item 4 and Fig. 14, represents a class of locomotives having an interesting history. The first of these was built in 1925, for light freight service. However, a general program of rehabilitating Australian motive power, initiated in 1927, resulted in the conversion of these locomotives to Mikados, special consideration being given, in making the change, to the early likelihood of altering the gage from 66 to 56½ in. After repeated orders over a period of years for additional 2-8-2's, the current year's order saw the reversion to the original 2-8-0 design, because of its suitability for light trains. The two types have a maximum number of parts in common.

Item 10 is another Victorian Railways shop-built locomotive of new design primarily intended to take the crack train of the Commonwealth weighing 550 long tons up a 2.1 per cent grade at 20 mph. This is the largest locomotive in Australia, and examination of its proportions shows that it would be quite at home in Table 3. Sufficient tractive force within severe clearance limits could only be obtained by the use of the three-cylinder arrangement.

Operators of the narrow-gage railways of South America definitely prefer a nonarticulated engine, and item 6 (Fig. 15) is representative of a number of 4-10-2 and 2-10-4 engines built for export in recent years. Item 7 (Fig. 16) is a passenger Pacific of intermediate weight built by Vulcan Foundry for service in India. There are one lighter and two heavier classes in service. This is one of the standard types designed by the engineers of the Indian Railway Board. Item 8 is a 4-8-2 passenger engine built in Barcelona for service on the Madrid, Zargosa and Alicante Railway, Fig. 17. Item 9 (Fig. 18) is another Indian engine, a 4-4-2 originally built in 1905–1908 for the Great Indian Peninsula Railway. In 1925–1928, the engine was reboilered, the new boiler having super-

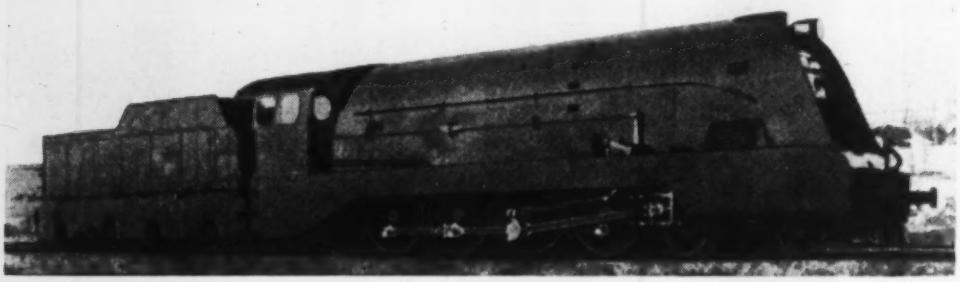


FIG. 17 MADRID, ZARGOSA & ALICANTE 4-8 2

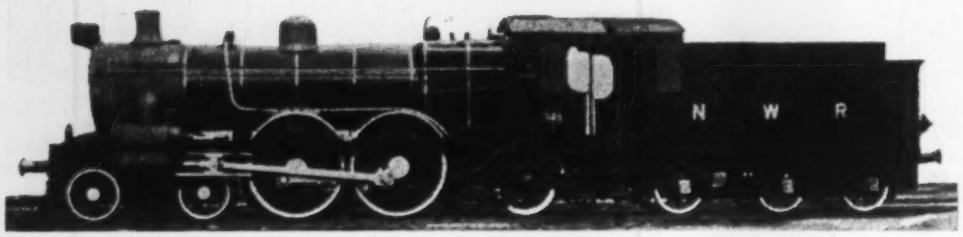


FIG. 18 REBUILT 4-4-2 NORTH-WESTERN RAILWAY OF INDIA

FIG. 19 ATCHISON, TOPEKA & SANTA FE 5400-HP DIESEL-ELECTRIC FREIGHT LOCOMOTIVE

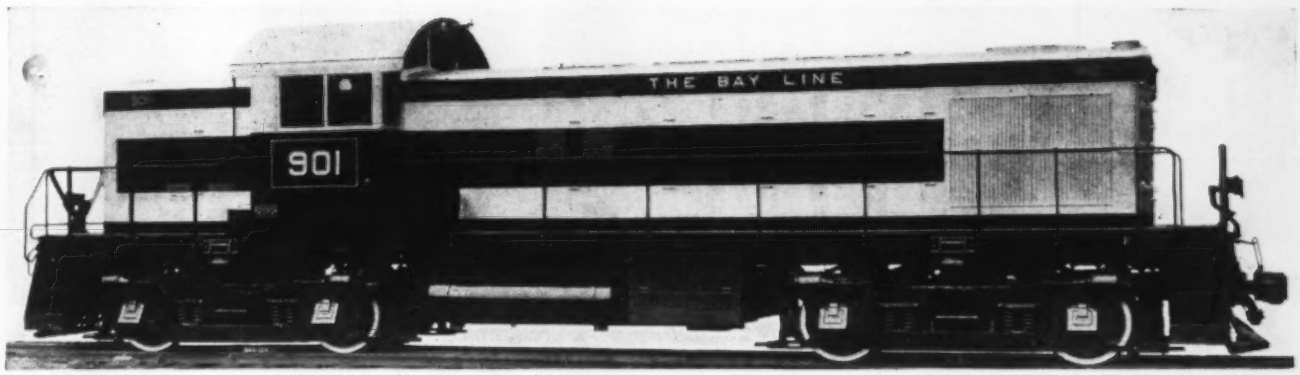


FIG. 20 AMERICAN LOCOMOTIVE COMPANY 1000-HP DIESEL-ELECTRIC ROAD SWITCHER

heaters; at the same time, the cylinders were increased in diameter and fitted with outside piston valves, the original Stevenson valve motions being retained. On the second rebuilding, which began in 1937, the engines were equipped with new frames (plates), through equalization, outside roller-bearing trailer journals, trailing wheels moved back 1 ft to improve weight distribution and hopper-type ashpans.

FIG. 21 GENERAL ELECTRIC 1000-HP DIESEL-ELECTRIC FOR PANAMA RAILROAD

two 200-gpm water pumps, and forced-air circulation through clutches. Dynamic braking is provided by reconnecting so that the traction motors may be run as generators; the power thus generated being dissipated in air-cooled stainless-steel grids in the roof. Dynamic braking produces a retarding force of 80,000 lb at 22 mph, and 54,000 lb at 33 mph, requiring the dissipation, in each case, of about 4700 hp.

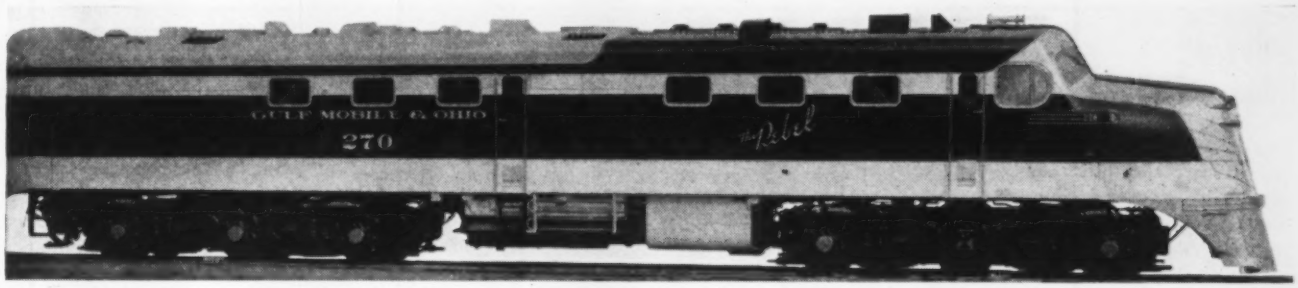


FIG. 22 GULF, MOBILE & OHIO 1000-HP DIESEL-ELECTRIC PASSENGER LOCOMOTIVE

OIL-ELECTRIC LOCOMOTIVES AND TRAINS

The installation and a transcontinental test run of the first railway-owned Diesel-electric freight locomotive stands out as one of the year's notable events. The locomotive, which was designed and built by the Electro-Motive Corporation, is shown in Fig. 19. It is a four-section unit, each section being carried on two four-wheel trucks, the outer axles on each truck being driving axles. There are therefore 16 driving axles, carrying a total weight of 923,000 lb. Each section carries a 1350-hp engine. The wheels are 40 in. in diameter. The locomotive proved capable of developing its full rated tractive force of 220,000 lb, as was demonstrated by the dynamometer readings.

The main engines are two-cycle type with sixteen cylinders. Each engine is direct-connected to a 600-v direct-current generator and a two-stage three-cylinder air compressor. A supplemental low-voltage generator is belt-driven from the main generators. Each main generator feeds four traction motors, two in each truck assembly. The cooling system consists of

In the road test, the locomotive was on the road 72.5 hr, actually running 54.6 hr at an average speed of 24.3 mph, hauling trains ranging from 49 to 68 cars for a total production of 5171 thousand gross ton-miles. The total fuel consumption was 10,830 gal of oil, for 198,858 million foot-pounds of work at the drawbar, which is 2.09 gal per thousand gross ton-miles, or 0.0542 gal per million foot-pounds. If a gallon of oil carries 160,000 Btu, this is 8550 Btu per million foot-pounds, or a thermal efficiency of $\frac{1{,}000{,}000 \times 100}{8550 \times 778}$ or practically 15 per cent. The road test was really intended to prove the reliability of the engine and its working ability on a long run. These were demonstrated in a completely satisfactory manner. No attempts at speed or load records were made. The fact that the locomotive readily handled the test train at its maximum weight, on one division with 0.6 per cent grade, at speeds up to 68 mph, indicates that the test train did not tax its capacity.

Another development in this field is the combination road-and-switching type Diesel-electric locomotive developed by the American Locomotive Company and General Electric Company,

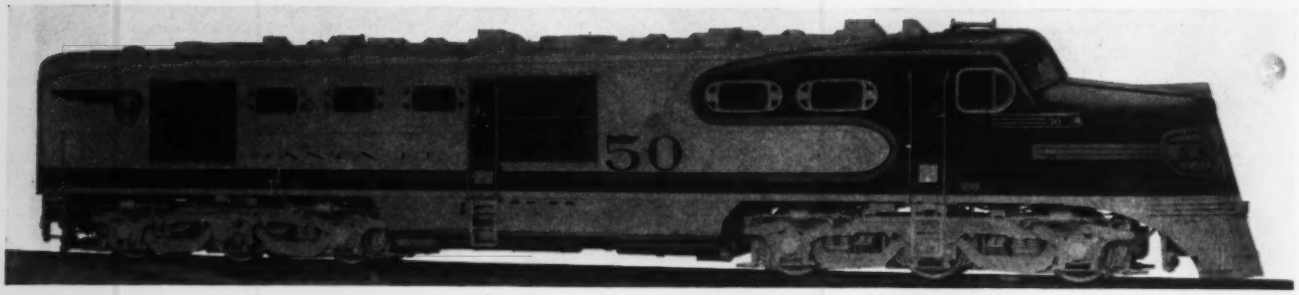


FIG. 23 ATCHISON, TOPEKA & SANTA FE SUPER-CHIEF, UNIT A

FIG. 24 ATCHISON, TOPEKA & SANTA FE SUPER-CHIEF, UNIT B

jointly. These engines, Fig. 20, are slightly longer and heavier than the regular switcher of the same rating. They have the same 1000-hp Büchi supercharged, six-cylinder engine, and a higher gear ratio.

Table 2 indicates the extensive adoption of the Diesel-electric switcher for yard service, the usual capacities being 600 to 660 hp and 1000 hp. Of the heavier class, the 95-ton General Electric engine for the Panama Railroad, shown in Fig. 21, is an example. There is also a considerable increase in the number of 2000-hp passenger engines, designed as "spares" for original streamliner equipment, or for operation with any train desired, as illustrated by the Alco-built 2000-hp locomotive for the G.M.&O. This locomotive, Fig. 22, has two engines, Büchi system turbocharged with six $12^1/_2$-in. × 13-in. cylinders each, and weighs 317,000 lb. New two-section engines for the Santa-Fe's *Super Chief* are shown in Fig. 23, the *A* unit, and Fig. 24, the *B* unit. Cylinders are identical with the G.M.&O. engines just cited; the *A* unit weighs 324,500 lb and the *B* unit 329,000 lb. The trucks have 41-in. wheels and a 15-ft 4-in. wheel base. The number of light units in the range of 350 hp and 44 tons weight is also rapidly increasing. It seems to be established that such an engine is economically justified if it can only work one shift per day.

FIG. 25 GENERAL ELECTRIC 44-TON DIESEL-ELECTRIC SWITCHER

Typical of engines of this class is the General Electric 44-ton switcher, Fig. 25. This engine has two four-wheel trucks, a steeple-type cab, and is powered by two 190-hp Caterpillar Diesel engines directly connected to railway-type generators. All axles are driven by nose-suspended traction motors. The working-order weight is 89,000 lb; the maximum starting tractive effort is 26,400 lb; the continuous tractive-force rating is 13,000 lb at 7.1 mph; and the output is 245 hp. Performance curves show that, with a 500-ton trailing load, this engine can attain a speed of 24 mph on the level in a distance of 24,000 ft.

Among recent Diesel-electric trains, the Budd-built D.&R.G.W. *Prospectors* have the most novel features. Each of these "pocket streamliners" consists of two cars; each train having a variety of passenger accommodations, including reclining chair sections, "chambrettes," full-size dressing rooms, buffet, diner, and observation-lounge. Power is derived from two pancake-style horizontal Diesel engines, suspended under the floor of each car, one adjacent to each truck. Constant horsepower is maintained at all altitudes by a "normalizer," belt-driven from the traction generator, which keeps air in the intake manifold at constant pressure, regardless of the altitude. The forward car contains a control cab, baggage and express space, and the reclining-chair section with 44 seats, while the second car contains sleeping accommodations for 18, the kitchen, an eight-seat dinette, and a four-seat observation-lounge. Each car is 75 ft long and weighs 65 tons, ready to run. These cars are not designed to operate in trains with conventional equipment, consequently, they are designed to meet A.A.R. requirements for buffing on unit trains. Floor stringers and side sills have been so designed that a center sill could be omitted.

Each of the four engines is rated 192 hp at 1600 rpm, and each has six $5^1/_2$-in × 6-in. cylinders. The engines are started by special windings in the traction generators. Variable-speed governors regulate the fuel supply for all engine speeds. Brake operation is on the HSC system with electropneumatic control, air being supplied by two motor-driven compressors in the

baggage room. Foundation brake rigging is of the Budd disk type described later.

Each truck is a four-wheeled power unit with a traction motor on each axle. The armature shaft is perpendicular to the axle; the latter being driven through bevel gears. The traction generators are of ample capacity to provide over 100 kw for traction and about 12 kw for auxiliaries. On a basis of 85 per cent motor efficiency, the horsepower at the rail is 456, or 3.28 hp per ton of train, fully loaded. Between Denver and the Moffat Tunnel, these trains must climb a 1.68 per cent grade 40 miles long, which would overtax the ordinary hourly rating, hence, the continuous rating must be sufficient to permit the train to climb this grade at 30 mph, and must also be consistent for maximum-speed requirements on level track and down-grades. The rating permits attaining 75 mph on level track.

NEW PRINCIPLE IN RAILWAY BRAKING

The Budd disk brake introduces a new principle in railway braking. Its essentials are blower-cooled disks bolted to the wheel hubs in contact with composition-lined "shoes." One shoe lies on each side of each disk, the pressure being exerted by the action of a pair of tongs, fulcrumed just outside the disk radius. Each shoe covers about one fourth of the area of the disk. The disk casting consists of two faces separated by vanes which act as impellers for ventilating air. The regular brake system of the train operates the new brake, the air-cylinder push rods bearing against the outer extremity of the tongs. Deceleration is uniform from beginning to end, and stopping distances are thereby reduced, attributable to immediate attainment of maximum deceleration. Absence of noise and smoothness of stopping improve passenger reaction to an extent permitting considerably higher retardation than permitted by conventional brake appliances.

Fig. 26 shows the truck assembled completely with traction-motor commutators, bevel-gear cases, brake disks, and shoes clearly visible.

Fig. 27 shows the wheel-and-axle assembly with motor, bevel-gear casing, brake disks, fulcrum for tongs, shoes, and brake cylinder bolted to the gear housing.

ADAPTING MODERN OIL-ENGINED UNITS TO LOCAL SERVICE

The adaptation of the streamliner to electric-railway service calls for note in this report. The two "Electroliners" of the Chicago, North Shore, and Milwaukee were put into service about April. Each train consists of two luxury-coach-end cars with 40 seats each, i.e., a 40-seat regular coach and a tavern lounge. The four bodies are mounted on five trucks, being thus fully articulated. There are two traction motors of 125-hp

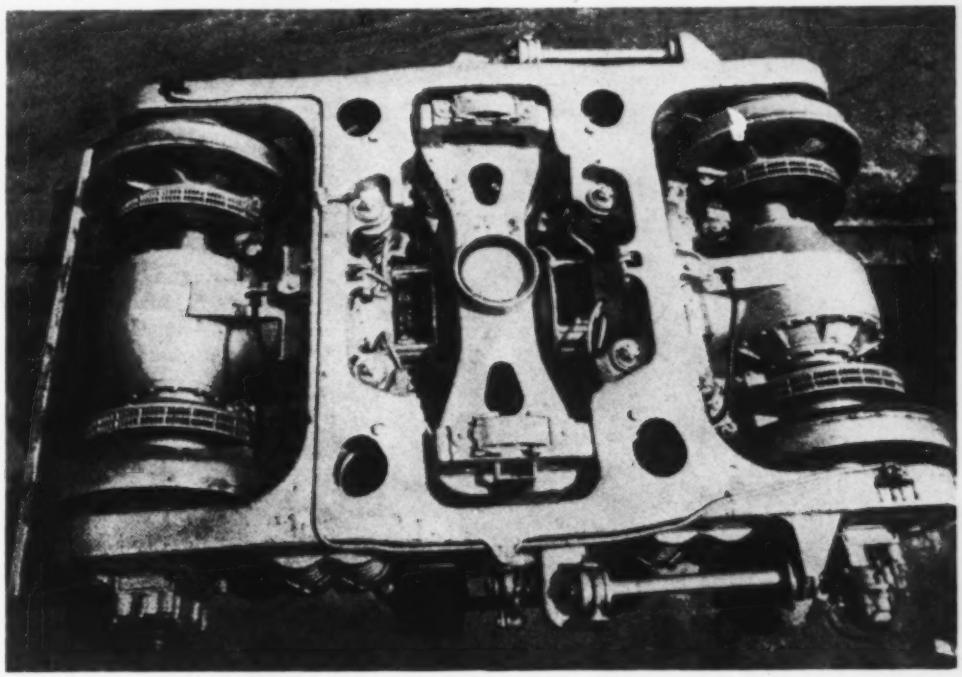


FIG. 26 "PROSPECTOR" TRUCK ASSEMBLY

FIG. 27 "PROSPECTOR" WHEEL-AND-AXLE ASSEMBLY

rating on each of four trucks against a ready-to-run weight of 100 tons, i.e., 10 hp per ton. The entire train is 155 ft 4 in. long. The two middle cars are without side entrances, the only ingress being through the center entrances of the end cars. The motors are mounted rigidly on the truck frames and drive the axles through flexible connections.

Another case of following a very general European practice is the introduction by the Illinois Central of two single-oil-engine mechanical-drive cars for high-speed local passenger service. These cars are substantially similar to the American Car and Foundry Company's cars previously built for the Susquehanna, except for end entrance, and differ from each other only in the styling of the high-color finish. The cars are built of low-alloy high-tensile steel, to withstand a 100,000-lb buffing load. Power is supplied by two 225-hp engines to twin disk clutches and torque converters to a geared driving axle in each truck. The cars weigh slightly less than 90,000 lb ready for pay load. The seating capacities are 61 and 69 passengers, respectively, in the two cars, differing because of the necessity of dividing the passenger space into two compartments on one of the cars, and consequently varying arrangements of buffet, pantry, and toilet accommodations. The cars are designed for a maximum speed of 73 mph, to which they can accelerate on level track in 2 miles or 2.9 min. The engines are of the Waukesha-Hesselman horizontal or pancake type. They burn Diesel fuel oil but are not Diesels, being spark ignited. Each engine develops 225 hp at 1800 rpm and each may be controlled separately if desired. The cylinders are $6^1/_4$ in. $\times$ $6^1/_2$ in.

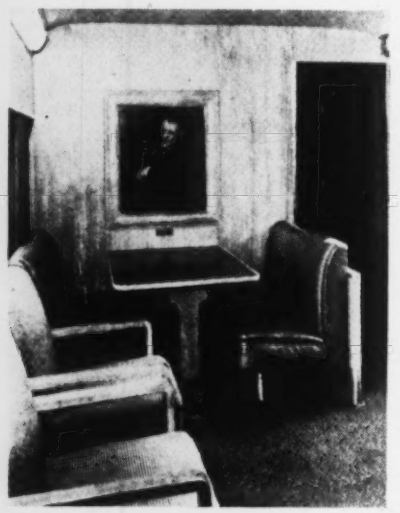


FIG. 28 INTERIOR OF LOUNGE ON THE "JAMES WHITCOMB RILEY"

FIG. 29 INTERIOR OF LOUNGE ON THE "JAMES WHITCOMB RILEY"

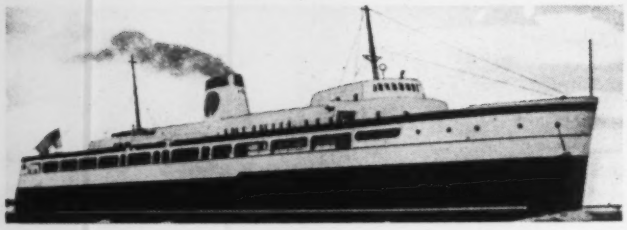


FIG. 30 CARFERRY "CITY OF MIDLAND 41"

NEW PASSENGER CARS

Of the many new trains of the year it would appear that the *James Whitcomb Riley*, New York Central's Chicago-Cincinnati steam streamliner, has achieved the maximum variation from the conventional railway-car appearance. Two observation-lounge interiors are shown in Figs. 28 and 29.

Southern Pacific new streamliner cars (Pullman Standard) represent considerable reversion to the articulated arrangements characterizing early equipment of this type. Of 51 body units, 12 are mounted in groups of three, and 28 in pairs.

New Budd coach-train cars, featuring square ends, the elimination of bulkhead seats, enlarged washrooms, with two hoppers each, the latter in separate closed stalls, provide 64 seats including washroom space.

Regularly scheduled daily passenger runs in the United States and Canada totaled 63,447 miles at the first of the year, and, adding less-than-daily streamliners, the figure is 73,165 miles.

Promising to meet a long-felt need is the wheel-slip controller, developed by the American Brake Shoe & Foundry Company,

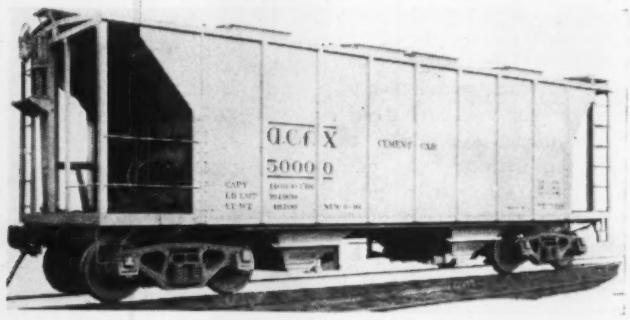


FIG. 31 AMERICAN CAR & FOUNDRY COVERED HOPPER CAR

FIG. 32 CROSS-BEAM APPLICATION ON MILWAUKEE BOXCAR

preliminary tests of which (on an articulating truck on a Burlington Zephyr) were reported in mid-year. The action of the device is based on the principle that slipping axles rotate relatively to each other. This relative rotation energizes a relay which controls brake-cylinder pressure. When slipping starts, the pressure in the brake cylinders involved is rapidly bled off. As soon as the relative rotation ceases, the brake-cylinder pressure builds up again. The resulting loss of braking effect is inconsiderable.

Probably a note of progress not customarily mentioned in such a report as this should be included here. The importance of lake-train ferry service is indicated by the fact that the Père Marquette Railway, in 1939, moved 1,700,000 tons of freight, 18,600 automobiles, and 60,000 passengers across Lake Michigan. The ferry, *City of Midland 41*, launched on September 18, 1940, made its first regular trip on March 12, 1941. This stern-loading steamer accommodates 54 freight cars on its main deck, 50 automobiles on the upper deck, and provides luxurious passenger accommodations, Fig. 30.

The railways and the Pullman Company combined had 12,511 air-conditioned cars in service on July 1, 1941.

FIG. 33 MILWAUKEE DOUBLE-SHEATHED 50-TON BOXCAR

FREIGHT-CAR DEVELOPMENTS

The increasing use of covered hopper cars for the transport of cement and similar commodities requiring weather protection has resulted in a number of new designs of this type of car.

The American Car & Foundry Company is offering a 70-ton two-hopper car with eight hatches, having a light weight of 48,100 lb. As compared with the A.A.R. 70-ton standard-design hopper car, this is a saving of 790 lb in the light weight. The cubic capacity of the A.C.F. car is such that it may be loaded to the revenue load limit of 161,900 lb, or 81 tons. Cement when blown into such a car weighs only about 80 lb per cu ft, as against 92 to 96 lb when shaken down by car movement. Hence, to carry the maximum load, a cubic capacity of slightly more than 2000 is required, which is provided in this car by loading up to the top of the side plates (actually 2040 cu ft). The car represents a distinct gain over previous designs with a 7 per cent decrease in light weight, and a corresponding 2.2 per cent increase in revenue load. At full load the revenue load is 77 per cent of the gross weight. The sample car is built of ordinary structural steels, with a combination of welding and riveting, the former predominating. Special attention was given to producing smooth interior surfaces, Fig. 31.

Appropriate to possible gun and similar loads, and immediately applicable to the handling of ingot molds between steel plants, the Greenville Steel Car Company has delivered a well car 90 ft long over pulling faces, having a load capacity (rail-load limit) of 263 tons. The well-body was constructed by welding together seven long H-beams, each of these beams in turn being made up of five shorter sections welded together. A combination of Thermit and arc welding was used in this fabrication. The well-body is carried by two auxiliary platforms, and these in turn rest directly on the trucks. These latter are six-wheel Buckeye trucks with 7-in. × 14-in. journals and 36-in. rolled wheels. The brake installation is two sets of AB equipment and eight 10-in. × 8-in. brake cylinders, one on each side of each truck, each cylinder operating the clasp-brake system for a set of three wheels.

An example of large-scale-equipment construction in railway-operated shops is furnished by the Burlington thousand-car project. Work on these cars, which are essentially built of copper-bearing steel by a combination of welding and riveting, is divided into twenty-five stages, a stage-to-stage move being made every 38 min. The cars are of the double-sheathed type, conforming to A.A.R. standards in all essentials. Inside dimensions are 40 ft 6 in. × 9 ft 2 in. × 10 ft 6 in., with Douglas-fir plywood ceiling and end lining. The volume is 3898 cu ft, the light weight 46,300 lb, and the load limit 122,700 lb. Fifty of the cars are equipped for passenger-train head-end service, with Allied full-suction truck and steam and air signal lines. The special equipment used increases the light weight 3600 lb. Youngstown prefabricated car sides and Murphy solid-steel roofs are used. Five different types of trucks are fitted. All cars except those intended for passenger-train service are equipped with 33-in. chilled wheels, the latter having two-wear rolled wheels.

The Milton Shops of the American Car & Foundry Company have completed five tank cars designed for service where the loading must be protected from metallic contamination. These are the first all-welded units of nickel-clad steel. The tanks are 32 ft × 86 1/4 in. and have a capacity of 10,000 gal. The thickness of pure nickel is 1/40 in. in the finished sheets. To facilitate unloading, by providing heating if necessary, a cradle of flattened pipe coils is laid on the tank bottom, all pipe being buried in 6 in. of fiber-glass insulation. Six lengths of coil on each side of the tank extend almost its full length.

The Milwaukee Road has completed and put into service a large shop-built order of 50-ton boxcars. These are lightweight double-sheathed all-welded construction with a volume of 3898 cu ft and an empty weight of 42,600 lb, corresponding to 126,400 lb load limit. A striking feature of the appearance of these cars is a set of six parallel bulbs or grooves running the full length of the car. These grooves permit the installation, at twelve positions along the car, of flush pockets in the side lining which permit the use of special cross-beams for double- or triple-deck loading. The cross-beams are stored under the floor of the car when not required, and are sealed to prevent theft. The pockets can also be used to anchor metal banding, as a means of bracing the load, thus saving injury to the side lining by the nailing on and removing of cleats. Fig. 32 shows the outside appearance of the car. Fig. 33 shows the application of the cross-beams for double-deck loading, temporary flooring (grain doors) over the beams, and metal banding to hold a mixed load.

RESEARCH ACTIVITIES DURING THE YEAR

Research accomplishments reported during the year include the tests of the poppet-valve locomotive by the Pennsylvania, already mentioned; the transcontinental service tests of the Santa Fe Diesel freight engines; standing tests of locomotive boilers, as a means of determining with accuracy quantitative as well as qualitative results applicable in particular to front-end design. By means of mixing the steam from the boiler with cold water sprayed into the cylinders, the actual state of the exhaust steam at the nozzle can be duplicated, producing results checking accurately with results secured from a locomotive on the road. Records of further steam research in the matter of improving superheater action are reported by the Superheater Company; and extensive work has been done in the direction of determining the best methods of counterbalancing the driving wheels, especially the main pair.

Several years ago the Superheater Company undertook an extensive research on superheater units, recognizing that the type E unit of four single loops was producing better results than the older type A but that there were large numbers of locomotives in service equipped with the latter arrangement, which might advantageously be replaced by a unit, interchangeable with that type, but approaching in efficiency the type E unit. A test apparatus was built permitting the examination of the performance of one unit at a time under controllable conditions of steam flow, gas flow, and temperature, so that the actual locomotive conditions could be simulated. Results of trials by groups or types of units are summarized as follows:

1 Division of the steam stream into smaller pipes secured a moderate increased superheat as desired, but materially increased the friction of the gas flow so that such a unit, interchanged with the normal type A arrangement, would defeat its purpose by diverting more of the hot gases to the small tubes.

2 Several designs of units, arranged to give increased turbulence to the flow both of gas and steam through the unit, were tried. It was found, as in the previous case, that the slight increase of superheat was obtained at the expense of increased friction or "draft loss."

3 A number of designs prepared for the purpose of improving the counterflow conditions gave no satisfactory results. The effect of these was to increase the heat transfer to the flue rather than to the superheater tubes.

4 A fourth group of test units was constructed in such a manner as to control the proportion of the hot gases flowing within the net of steam tubes to that flowing between the tubes and the flue wall. One of these arrangements gave results which showed up to 50 deg increase in superheat relative to the type A unit, thus warranting a regular road test. An even better result was obtained with a design of unit having an annular steam path at the front end providing good conditions of counterflow, but with the back end of the unit substantially similar in form to the present type A unit. This type, found satisfactory in road tests, is designated as the type HA unit.

LOCOMOTIVE MODERNIZATION

The North Western has a large number of 2-8-2's with 61-in. drivers. Many of these have been modernized to make them suitable for operation at a speed higher than 50 mph, the limitation placed on them when first put into operation, by increasing the drivers to 64 in., dynamically balancing the main wheels, and by improvements in the steam passages. A series of tests, in which rail stresses and rail loads were determined by means of magnetic strain gages, indicated that, for a maximum stress of 30,000 lb, these engines as delivered could be run at 61 mph. As cross-balanced, according to older standards, they could be run at 83 mph. By improved design of reciprocating parts and reduction of the reciprocating balance in all wheels, the critical stress was not attained until a speed of 84 mph was reached. Another criterion applied was that of calculated dynamic augment where the limiting speeds for the three cases were 53, 62, and 81 mph, respectively. Summarizing, the increase in safe speed is shown as follows:

Based on	Rail stress	Dynamic augment
Original engine	61 mph	53 mph
Modernized	83 mph	62 mph
Rebalance original	84 mph	81 mph

Another railway to report improved riding conditions for locomotives with modernized balancing is the Chicago Great Western. On this road, the tests dealt with 2-10-4 locomotives, built in 1930, with 29-in. × 32-in. cylinders and 63-in. driving wheels. These were equipped with the so-called tandem main rod, and were considerably deficient in revolving balance on the main wheels, while the remaining drivers carried some reciprocating balance. The speeding up of freight schedules led to concern over the rough-riding and rail-hammering effects of these locomotives, and improvements were made on a number of units. The improvements consisted of replacing the main and tandem rods by lighter parts, and the installation of Baldwin disk main wheels. The redesigned rods reduced the rotating weight on the main wheels by 309 lb. This was still further reduced by the design of the wheels (reducing the weight of the crank hub), the consequent rotating underbalance being reduced to practically nothing. At the same time, the new main wheels were dynamically balanced, which was permitted by the increased balance weight permitted by the wheel design. Road tests were run to compare the operation of the locomotive as built and as improved, using a Miner shock-measuring "impactograph" which records the number of shocks of a certain intensity (in terms of G) within a given distance graphically. The results of the test on a 20-mile section of track at a speed of about 49 mph are as follows:

	—Number of shocks in 20-mile run—	
Intensity of shock	Engine as built	Improved
$0.25G$	5536	3423
$0.50G$	1599	61
$0.75G$	123	0

The procedure of lightening the rods and applying new wheels with dynamic balance will continue to completion.

ACKNOWLEDGMENT

The compiler of the foregoing report acknowledges with appreciation the cooperation and assistance of members of Committee 6, and of *The Railway Age*, *Railway Mechanical Engineer*, *Railroad Gazette*, and *The Locomotive* (British).

1941 ANNUAL REPORT *to* E.C.P.D.

Work of Council's Committees Summarized

By ROBERT E. DOHERTY

CHAIRMAN, ENGINEERS' COUNCIL FOR PROFESSIONAL DEVELOPMENT

BEFORE reporting specifically regarding the work of the Council I wish to make a few general observations. In the first place, it has seemed clear that before E.C.P.D. could accelerate its progress toward the objectives stated in the charter it was essential that not only the officers and boards but also the rank and file of the constituent organizations understand much more fully than they have in the past what these objectives are and the importance of their achievement to the welfare of the country. An astonishing number of people, including some comparatively close to the work, have felt that the most important activity and the only significant achievement of E.C.P.D. have been in connection with the accrediting program. Yet the charter clearly indicates other purposes and activities—relating to selection and guidance, professional training, professional recognition—and these are also actively pursued by standing committees. And from the point of view of further advancement of the profession, and more important still, the welfare of the country, these other purposes and activities are, in the long run, unquestionably of equal importance with accrediting. Good students are not less essential than good schools. Hence, at the beginning of the year I strongly urged an educational campaign among the constituent organizations as one of the most important projects the Council could undertake. And I am confident that as the constructive purposes and results of the Council's work become clear, all constituent bodies will appraise the situation as it exists today, forget misunderstandings of the past, and see their way clear to support the Council's work.

An astonishing number of people, including some comparatively close to the work, have felt that the most important activity and the only significant achievement of E.C.P.D. have been in connection with the accrediting program. Yet the charter clearly indicates other purposes and activities—relating to selection and guidance, professional training, professional recognition—and these are also actively pursued by standing committees. And from the point of view of further advancement of the profession, and more important still, the welfare of the country, these other purposes and activities are, in the long run, unquestionably of equal importance with accrediting. Good students are not less essential than good schools. Hence, at the beginning of the year I strongly urged an educational campaign among the constituent organizations as one of the most important projects the Council could undertake. And I am confident that as the constructive purposes and results of the Council's work become clear, all constituent bodies will appraise the situation as it exists today, forget misunderstandings of the past, and see their way clear to support the Council's work.

The chairman's views regarding this matter, after discussion in executive-committee meetings, were presented in a report to the several boards of the constituent groups under the heading "E.C.P.D. Should Look Ahead." This report has been made available to the membership of several of the constituent organizations by publication in their respective journals. It urged that, in the interest of national welfare as well as professional development, the organizations cultivate more effective methods of cooperation than they have had in the past.

The machinery for the cultivation of such cooperation exists in E.C.P.D. The projects represented by its standing committees and by other objectives *having to do with professional development* afford a basis on which the organizations can work together. But the effectiveness of this cooperation will depend, in my opinion, altogether upon the effectiveness of plans devised by the Council to make use of the machinery wisely set up by the several participating bodies when the Council was organized. These plans must, it seems to me, include a more active participation than in the past by the representatives of the constituent bodies; and to accomplish this, there naturally must be a definite and a constructive program in which they can find an active interest. It is hardly to be expected that each of twenty-four different delegates will, on his own responsibility, think out what his organization should do toward E.C.P.D. objectives or what E.C.P.D. might do to further them. Hence the officers and committee chairmen of the Council must work with the delegates to formulate plans and procedures. Fostering cooperative effort has thus become one of our definite plans.

And finally, I would say a general word regarding financial responsibility for supporting the work of the Committee on Engineering Schools. From the beginning it has been the policy, and still is, that an engineering school should pay for the expense of the initial inspection to determine whether a curriculum should be accredited. Although all of the colleges have accepted this policy (some, however, under protest), there is nevertheless another side of the inspection plan on which the policy has not been so clear or so widely accepted. This relates to the question who should pay for *re*inspection of curricula that have already been added to the accredited list. A number of the colleges are unalterably opposed to the principle that they should pay this *re*inspection fee, and this opposition has made it extremely difficult for the officers of E.C.P.D. who administer the accrediting program. Hence this became a major question of policy. On the one side, such engineering colleges take the position that the E.C.P.D. and other accrediting agencies constitute an intolerable burden and nuisance in view of the combined expense in money and time of staff spent in preparing questionnaires and in looking after visiting delegations of inspection; that they were not responsible for the proposal to start the accrediting program in the first place, but rather it was the state boards and professional societies that wanted it; and that they now make sizable contributions toward the program through the time their faculty members and their official staff take from academic work in order to carry out E.C.P.D. committee assignments in connection with inspection programs at other institutions and the preparation of reports for E.C.P.D. On the other hand, the argument is proposed by some representatives of the

Presented at the Annual Meeting, New York, N. Y., Oct. 30, 1941, of The Engineers' Council for Professional Development.

constituent organizations that the accrediting program is valuable to the colleges both on account of the advice and counsel that may come to them as a result of the inspection and reinspection and through having their names appear on the accredited list. This matter was a question of extended debate at two meetings of the executive committee, since a decision to remove the burden of *re*inspection fee from the colleges would make an additional appropriation necessary from the constituent organizations. As indicated in detail under finances, the decision of the committee was in favor of relieving the colleges of this burden, and of asking the constituent organizations for increased appropriations.

NEW CHARTER FOR ENGINEERING EDUCATION

Engineering education in this country now has a charter to guide its development. In 1939 a special committee of the Society for the Promotion of Engineering Education undertook the statement of an educational philosophy and the formulation of definite objectives that might serve as the basis for the design of programs in engineering education. After extended work by the committee, representing a wide spread of points of view, the S.P.E.E. issued the report "Aims and Scope of Engineering Curricula."[1]

In view of the fact that the recommendations of this report naturally had definite relationship to the question of accrediting, the report was submitted to the Engineers' Council for Professional Development at the October, 1940, meeting, at which President Donald B. Prentice of the S.P.E.E. made a statement regarding this relationship to the Council's work. The Council of course referred the matter to the Committee on Engineering Schools, and I am happy to note in the report of Chairman Potter of this Committee that the provisions in the S.P.E.E. document have been endorsed by this committee.

For its educational leadership and the contribution thus made toward professional development by the Society for the Promotion of Engineering Education, the E.C.P.D. should be most grateful, and I express such gratitude on behalf of the Council.

E.C.P.D. ACTIVITIES

The work of the several committees is fully reported by the chairmen, but there are a few items that I also wish to mention.

In connection with selection and guidance, the Council was very appreciative of the proposal made by President Cullimore of Newark College of Engineering and sponsored by Dean Sackett's committee. It related to a joint study of E.C.P.D. and S.P.E.E. on "Aptitude Tests and Selective Devices" which have proved to be most effective in the selection of engineering students. The Council enthusiastically approved the project, which it was estimated would cost $4500, and expressed its gratitude to President Cullimore for his interest and his willingness to find the funds to finance the project.

Another item is the pamphlet "Engineering as a Career." After protracted study and repeated revisions, Chairman Sackett of the Committee on Selection and Guidance presented it in manuscript to the Council meeting in October, 1940. The Council expressed its gratitude to Dean Sackett for his untiring work in this connection and approved the manuscript for publication provided funds could be obtained for the purpose, and subject to review and approval by the Committee on Information. There was available from the sale of the old pamphlet a balance of approximately $2000, which was about one half the amount required for publication of a new pamphlet. The chairman of E.C.P.D. explored without avail every possible source of financial assistance that had been suggested. Hence the only recourse seemed to be a revision of the pamphlet which would reduce its volume and expense to a level that could be financed by the funds that were available. This problem was reviewed by the Committee on Information, and its proposal to undertake the revision was later reviewed and approved by the Executive Committee, the revised manuscript subject to approval by the Executive Committee. The revision will be ready for review and approval at the October, 1941, meeting of the Executive Committee. It is to be hoped that the new pamphlet will appear promptly after the October meeting, because there is great demand—about 10,000 copies per year—and the stock of the old pamphlet is exhausted.

The major effort of the Committee on Engineering Schools has of course been in connection with the accrediting program. The statesmanlike manner in which the numerous difficult problems of the committee have been handled by Dean Potter and his colleagues has greatly enhanced the prestige of E.C P.D. Dean Potter's second term on the Committee on Engineering Schools expires this year, and it is with sincere regret that the Council will lose his distinguished leadership. Needless to say, his contributions toward the work of E.C.P.D. were not confined alone to the activities of the Committee on Engineering Schools but spread over the whole program, including an extremely important role in connection with the financial support of the Council's work. And for all of this, I speak the gratitude of his colleagues on the Council.

The Committee on Professional Training also will lose the leadership of its present chairman. S. D. Kirkpatrick, who was vice-chairman during 1939-1940 and chairman during the current year, will be obliged to give up the chairmanship next year on account of his accepting the honor and new responsibility of the presidency of the American Institute of Chemical Engineers. During his first term as a member and later as vice-chairman of the Committee on Professional Training, he had made important contributions to the Council's work, and in his brief term as chairman of the committee he has carried forward the program with the same characteristic thought and vigor. We are grateful to him and reluctantly give him up to the leadership of his own profession.

Of all the problems with which E.C.P.D. has dealt, professional recognition has proved the most perplexing. The difficulty lies primarily and inherently in the fact that the profession of engineering is itself in a state of evolution and hence there has not yet been evolved a definite concept that would receive general acceptance as to what constitutes the profession. Without this, there is little promise of arriving at a consensus as to criteria of professional recognition. The persistent and unremitting work of C. F. Scott, chairman of the Committee on Professional Recognition, is, I believe, bringing a gradual clarification of the elemental considerations that must be dealt with before a satisfactory solution of the problem can be achieved. With certain de facto forms of recognition in different areas and with slowly crystallizing concepts of what the profession is, Professor Scott and his committee aim first to secure clarification of thought and views, recognizing that the reconciliation or adjustment of fundamentally different concepts calls not for precipitous action but for continuing long-range study and pursuit. Following E.C.P.D. methods it begins with youth, concentrating on the engineering student by aiming to arouse his interest in understanding the engineering profession and "professional recognition"—the goal he seeks. The committee observes that the immediate objective of E.C.P.D., "the development of the young engineer to professional standing," concerns the individual; but its culminating aim, "greater effectiveness in dealing with technical, social, and economic problems," calls for group action, a profession. The young engineer is but partially developed if he lacks the capability and the attitude for group action in a profession.

[1] Published in MECHANICAL ENGINEERING, October, 1940, pp. 727–730, under the title "Whither Engineering Education?"

The work of the Committee on Ethics was inherited from the American Engineering Council when the latter dissolved. At its meeting in January, 1941, the Executive Committee voted to take over the sponsorship of this work, and the Committee on Ethics under the chairmanship of Prof. D. C. Jackson and with a few additional members appointed by the Council has continued the study and preparation of a code of ethics. The committee has made a progress report including a preliminary tentative draft. I strongly recommend that the Council request the committee to continue its study and look forward to having a final report at the Annual Meeting in 1942.

The educational campaign, to which I have already referred, is another Council activity that I wish to touch more specifically. There have been three lines. One was the chairman's report to the Boards, "E.C.P.D. Should Look Ahead,"[2] which gave not only the chairman's view as to the opportunities and responsibilities that lie before E.C.P.D. but also a brief report of the active work of the several committees. The second was the plan of the Committee on Information to prepare for the press, especially for the publications reaching members of the engineering profession, informative releases regarding the work of the Council. And finally a plan was made to encourage sessions at meetings of the constituent organizations at which the work of E.C.P.D. would be presented and discussed. There have been two such meetings and two more are scheduled, as reported by Professor Scott, chairman of the Committee on Professional Recognition, who has taken a leading interest in this plan.

In this latter connection, a report from J. F. Fairman, an A.I.E.E. representative on the Council, includes an idea which I think is highly significant. It is, that the way to achieve understanding of and active interest in the purposes of E.C.P.D. by the members of the constituent organizations is to have the local chapters take an active hand; and that the way to bring this about is to have the whole matter, including a plan, discussed at the regular session of officers, delegates, and members at the A.I.E.E. annual convention. These are the people responsible for section activities, and if they understand the plan and are convinced, something will come of it when they go back home. It is the conclusion of Mr. Fairman and his associates that the most likely of the Council's problems about which the local sections might become active is that of selection and guidance. Their work might be patterned along the lines of the procedure already developed in certain metropolitan areas in connection with the work of the Committee on Selection and Guidance. Once this was under way, a second step taken by a section might be in relation to the work of the Committee on Professional Training in helping young graduates to become appropriately oriented and active in their own professional development. And so on. This general point of view and plan seem to me most promising, and the fact that the A.I.E.E., through the leadership of Mr. Fairman and his associates, is proceeding along these lines is most encouraging.

TECHNICAL INSTITUTES

The relationship of technical institutes to the whole scheme of technological education in this country has been a matter of continuing concern to the Council. In his annual report last year Chairman Perry outlined the beginning of active consideration of this problem under the sponsorship of E.C.P.D. President Parke Rexford Kolbe of Drexel Institute of Technology and Dean H. P. Hammond of Pennsylvania State College have undertaken the leadership in this important and difficult matter. President Kolbe called a meeting of officers of a number of technical institutes, and as a result a petition was submitted to E.C.P.D. that it consider the problem of accrediting of technical institutes. This was referred by Chairman Perry to the Committee on Engineering Schools, but after consideration it became clear in this committee that the question was too involved to allow a prompt decision to be reached; it was then recommended that a subcommittee including President Kolbe be appointed to continue study of the problem, and this was done.

[2] Published in MECHANICAL ENGINEERING, June, 1941, pp. 461–463, under the title "A Report to Engineers' Council for Professional Development."

CONSTITUENT MEMBERSHIP

Since the organization of E.C.P.D. the question has arisen from time to time as to whether the constituent membership should be increased. As reported by Chairman Perry last year, The Engineering Institute of Canada was welcomed as a new member of the Council, and this was done through the unanimous decision of the existing member organizations to recognize the common purposes and interest of engineers of the two great countries in connection with professional development. The international aspect of this move placed it in an altogether special category as regards institutional membership. There have been other problems in connection with engineering organizations in the United States, but the Council has not yet found it possible to dispose finally of the question of general policy here involved.

FINANCES

E.C.P.D. is solvent, but the financial situation is certainly not all that might be desired. As one indication of the limitations on its work I would mention that the funds available to the standing committees, excepting the Committee on Engineering Schools, for the important work they are expected to pursue, are limited in each case within the range of $300 to $600. One of the immediate problems before the Council is the provision of something approaching a reasonable appropriation in these cases.

The financing of the work of the Committee on Engineering Schools has had special aspects, as I have indicated earlier in this report. The problem of policy as to whether engineering schools should be assessed for *re*inspection of curricula was determined by the executive committee at its meeting in March—the schools were not to be assessed. Accordingly, constituent bodies were approached by the chairman with the request that they increase their appropriations to the work of the Council in order that this policy might be carried out. I am gratified to report that the A.I.E.E., the A.S.M.E., and the A.I.Ch.E. have doubled their appropriations, and that the A.S.C.E. will act upon our request in December. Thus it seems clear that we shall be able to carry out the policy adopted by the executive committee, and I express the Council's gratitude to the organizations that are making this possible.

I would report one further action of the executive committee. After considerable deliberation as to responsibility for the securing of funds for the Council's work, the executive committee decided for the present year to expand the Ways and Means Committee to include one representative from each of the constituent groups. In the absence of any action by the Ways and Means Committee, the Chairman of E.C.P.D., with such assistance as he could find—and he found good assistance—has taken the initiative in raising funds, and he is very grateful to Messrs. Potter, Seabury, Fairman, Davies, Stevenson, Tyler, and Dodge.

I close this report with an expression of my great appreciation of the cooperative attitude and interest of the officers, committees, and members of the Council, and I feel sure that their work during the year has given new impetus to the Council's programs at a time when, for the welfare of the country, this is most important.

E.C.P.D. HEARS MEMBERS' VIEWS

Representatives of Constituent Bodies Report Favorably and Offer Suggestions at 1941 Annual Meeting of the Council

MOST significant of the many features of the 1941 Annual Meeting of the Engineers' Council for Professional Development, held at the Engineering Societies Building, New York, N. Y., on October 30, were the reports of representatives of the constituent bodies of the Council on its effectiveness and its accomplishments. These reports were gratifying because of their favorable nature and because they afforded opportunity for individual assessments and for suggestions for future action. An attempt will be made later in this review to present the high lights of these reports.

By far the largest attendance ever recorded at a meeting of the Council was attributed to a number of guests who found opportunity to attend because of the annual meeting in New York earlier in the week of the National Council of State Boards of Engineering Examiners, one of the eight constituent bodies of E.C.P.D. Another notable fact in connection with attendance was the delegation of nine representatives of The Engineering Institute of Canada, headed by C. J. Mackenzie, president of the Institute.

OFFICERS AND COMMITTEES TO SERVE IN 1941–1942

Officers for the year 1941–1942 were elected as follows: Chairman, R. E. Doherty, president, Carnegie Institute of Technology, re-elected; vice-chairman, H. T. Woolson, member A.S.M.E., executive engineer, Chrysler Corporation, re-elected; secretary, H. H. Henline, national secretary A.I.E.E.; and assistant-secretary, A. B. Parsons, secretary A.I.M.E.

Chairman of the Council's committees for the coming year will be as follows: Committee on Engineering Schools, D. B. Prentice, member A.S.M.E., president Rose Polytechnic Institute; Committee on Professional Recognition, C. F. Scott, member A.S.M.E. (reappointment); Committee on Professional Training, E. S. Lee, member A.S.M.E., engineer, General Engineering Laboratory, General Electric Company, Schenectady, N. Y.; Committee on Student Selection and Guidance, R. L. Sackett, fellow A.S.M.E. (reappointment); Committee on Principles of Engineering Ethics, D. C. Jackson, member A.S.M.E. (reappointment).

It was decided to charge the Executive Committee with the duties of the Committee on Ways and Means, with the vice-chairman of the Council as member ex officio, and with the privilege of adding other members as occasion might demand.

STANDING COMMITTEES REPORT PROGRESS

The personnel of the Executive Committee for the ensuing year will be as follows: George W. Burpee, consulting engineer, Coverdale and Colpitts, New York, N. Y., A.S.C.E.; A. R. Stevenson, Jr., staff assistant to vice-president in charge of engineering, General Electric Company, A.S.M.E.; James F. Fairman, Consolidated Edison Company of New York, Inc., A.I.E.E.; C. C. Williams, president, Lehigh University, S.P.E.E.; B. F. Dodge, professor of chemical engineering, Yale University, A.I.Ch.E.; Chas. F. Scott, professor-emeritus of electrical engineering, Yale University, N.C.S.B.E.E.; and J. B. Challies, assistant general manager, The Shawinigan Water and Power Co., Montreal, P. Q., Canada, E.I.C. Representative of the A.I.M.E. on the Executive Committee has not yet been announced.

Reports of the committees, which had been mimeographed and distributed in advance of the meeting, were not read, but were briefly summarized in order to afford time for the presentation of reports of delegates from the sponsoring organizations. In view of the fact that the high lights of these committee reports are mentioned in the report of the Chairman to the Council, which is printed elsewhere in this issue, no attempt will be made at a summary in this review. The reports were accepted and will be published by the Council in its Ninth Annual Report.

UNIFIED ENGINEERING PROFESSION IN PROSPECT IN CANADA

What the constituent bodies of E.C.P.D. think about its work, what their own Societies have been doing in forwarding the purposes of the Council, and what might be done in the future formed the general scheme of reports presented by the representatives of those bodies.

The Engineering Institute of Canada was greatly impressed with the Council's accomplishments, said Mr. Challies, first of the representatives to report. He gave a brief summary of what the Institute had done and was planning to do to enhance the status of the engineering profession. He doubted that members of the Council had full knowledge of the Institute, which was an all-embracing engineering society and the only one of national scope in Canada. On the basis of comparative populations of Canada and the United States the membership of the Institute was equal to the combined membership of the other constituent bodies of E.C.P.D. All the ten Canadian engineering colleges would, he was sure, be accredited by E.C.P.D. if its accreditation were extended to include the institutions of the Dominion.

Registration and licensing of engineers in Canada had been initiated by the Institute. A "model act" had been drafted. Provincial associations of registered engineers worked closely with the Institute and concerned themselves with administration of the registration acts, leaving the Institute to foster the technical interests of engineers. Relationships between the associations and the Institute were cordial and further cooperation was being actively undertaken with the result that a truly unified engineering profession in Canada was imminent. It was the policy of the Institute to encourage undergraduates in the colleges to become student members, and, upon graduation, to seek membership in the profession and relationship to the Founder Societies.

Of present activities, Mr. Challies said, there was little to report owing to the war economy. A committee had been set up to concern itself with "the servicing of young engineers," and a Canadian edition of E.C.P.D.'s guidance booklet, "Engineering as a Career," was in progress under the title "The Profession of Engineering in Canada." As to the future, he concluded, engineers could count on the Engineering Institute of Canada pulling its load, the first duty being to help Britain win the war.

A.I.CH.E. LOOKS FORWARD TO BETTER COOPERATION WITH E.C.P.D.

Relations with E.C.P.D. were valued highly by the A.I. Ch.E., Mr. Kirkpatrick reported, and it was their hope that that appraisal was reciprocated. Although differences of

opinion, viewpoint, and procedure might have been disturbing, chemical engineers who had worked intimately with both organizations believed that better understanding and greater cooperation were fast developing.

That A.I.Ch.E. took seriously its relations with E.C.P.D. was attested by the fact that in recent years one fifth of the attention of the governing body had been given to common problems. Ever since the Institute had been founded in 1908 it had had an active continuing concern with engineering education, and as the founders, who had been trained in mechanical engineering or chemistry, had seen the need for a different type of preparation than they had received, they had set about studying curricula and had worked with educational institutions. Mr. Kirkpatrick reviewed briefly the recommendations by Arthur D. Little, in 1915, which had led to the first modern course. Dr. Little had been chairman of the Institute's committee on education in 1922, and in 1925 the first list of institutions accredited in chemical engineering had been published by the Institute.

This long investment of time and study of problems peculiar to chemical-engineering education, Mr. Kirkpatrick continued, had led the A.I.Ch.E. to insist on a greater measure of control over accrediting than would be the case if they were completely to relinquish this authority to E.C.P.D. The Institute had joined in the Council's accrediting program on that basis and all of its actions since that time had reaffirmed this position. This particular relationship had been different and had led to misunderstandings, but it could and must be made to work more satisfactorily, he asserted. The Institute's procedure had been "streamlined," and expert clerical assistance had been employed to expedite cooperative work. It was therefore his hope that there would no longer be cause for criticism, but the Institute would always welcome constructive suggestions.

The Institute had been one of the first to appoint at E.C.P.D.'s suggestion a cooperating committee on professional guidance. It had helped to organize the New York engineer's committee on student guidance. One of its members, the late Ellery L. Wilson, had participated in founding the junior engineering group in Providence, R. I., and had been instrumental in the formation of similar groups in New York, Philadelphia, Wilmington, Del., and Charleston, W. Va.

Evidence of the chemical engineer's interest in student selection and professional development, Mr. Kirkpatrick asserted, had been found in the results of the questionnaire sent out in 1940 under the joint auspices of the E.C.P.D. committees on student selection and professional training. Through its standing committee on legislation the Institute had kept in close touch with the E.C.P.D. Committee on Professional Recognition and in the progress in registration and licensing as reported by N.C.S.B.E.E. Mr. Kirkpatrick sensed a growing interest in these matters.

As to the future, Mr. Kirkpatrick expressed the hope that the Institute and E.C.P.D. would work together more closely. The Institute would welcome an opportunity for a joint meeting along the lines of the A.S.M.E.-E.C.P.D. program at Kansas City in June, 1941.

A.S.C.E. SERVES NOTICE OF CHARTER REVOCATION ON CHAPTERS IN UNACCREDITED SCHOOLS

Reporting for the A.S.C.E., Mr. Burpee stated that that society's Committee on Engineering Education had suggested that E.C.P.D. might well limit its work of accrediting curricula to the five major fields and general engineering. This committee's views had been reaffirmed by the A.S.C.E. Board of Direction in April, 1941. The committee agreed with Dr. Jackson's report[1] that "undergraduate curricula should be made broader and more fundamental through increased emphasis on basic science and humanistic and social studies," including "the abandonment of effort to develop the stabilized skills that are now emphasized."

The A.S.C.E., Mr. Burpee said, had continued its active participation in the program of student guidance, and through its 121 student chapters and junior branches of local sections was attempting to foster the development of a professional viewpoint. Student chapters had been furnished copies of the E.C.P.D. bulletin, "Suggestions to Juniors."

At its recent meeting, Mr. Burpee continued, the A.S.C.E. Board of Direction had voted that "student chapters at institutions where civil-engineering curricula had not been accredited by E.C.P.D. would have their charters withdrawn on Jan. 1, 1944, unless these curricula had been accredited by that time."

Chas. F. Scott had addressed the A.S.C.E. Local Sections Conference in Chicago during October on "Interrelation of Local Sections and E.C.P.D."

A.S.C.E. members, he concluded, were greatly concerned with the solidarity of the engineering profession during these times and looked to E.C.P.D. to stimulate the consciousness of the profession at large and particularly to devise tools to use in the development of young engineers in their technical training, their engineering experience, their objective and scientific approach toward their problems, and their ethical attitude toward their undertakings.

SUGGESTS GREATER PUBLICITY FOR E.C.P.D.

A "vote of confidence" in E.C.P.D. was extended by Mr. Fairman speaking for A.I.E.E. The Institute's faith in E.C.P.D. had taken concrete form, he said, by the doubling of its annual contribution toward the Council's activities. As one of the Institute's representatives he had secured approval of the publication in *Electrical Engineering* of President Doherty's report "E.C.P.D. Should Look Ahead."

It was Mr. Fairman's opinion that E.C.P.D. should carry on its activities. The Institute's Committee on Education had taken the unusual course of recommending that *it* undertake the job of aid in setting up activities in student selection and guidance in 20 A.I.E.E. local sections, instead of turning it over to some other committee. He deplored the habitual attitude of "let George do it." Sessions relating to E.C.P.D. had been arranged for the Institute's midwinter convention, and vocational training was to be covered at the spring meeting.

BOOKLET FOR ENGINEERING GRADUATES PROPOSED

Stating that as incoming A.I.M.E. representative of E.C.P.D. he had been asked at the last moment to prepare a report, Mr. Chedsey said that what he had to say had not been approved by his colleagues because of lack of time.

The activities of A.I.M.E. which lay in the field of E.C.P.D., he said, were mostly covered by its Mineral Industry Education Division. There was also a Student Relations Committee which concerned itself mostly with relations with undergraduates and worked mostly through student chapters and affiliated student societies. The central committee aided by securing speakers for student meetings, by arranging for visits by A.I.M.E. officials, and by establishing contacts for field trips. No workable method had as yet been found to cover the need for systematic contact with young engineers after graduation, although the subject had been given some consideration.

Two suggestions as to what additional activities E.C.P.D.

[1] A review of Dr. Jackson's report "Present Status and Trends in Engineering Education in the United States," was published in MECHANICAL ENGINEERING, Dec., 1939, pp. 912–914, under the title "By-Products of E.C.P.D."

might undertake were made by Mr. Chedsey. The first was a booklet for engineering graduates "setting forth why and when they should consider becoming registered as professional engineers, with a brief summary of the laws or regulations of the various states that would be of help to them in this procedure." He also outlined other matters that the booklet might cover. His second suggestion was "the encouragement, and possibly some aid in direct development, by a committee of E.C.P.D., of personnel methods, through the use of scientific and engineering aids, in other words, assisting in the development of so-called 'Human Engineering.'"

During the year, Mr. Chedsey said, the A.I.M.E. had contributed in several ways toward furthering the objectives of E.C.P.D. A biennial review of the schools of mineral technology had been published by Prof. W. B. Plank, of Lafayette College. The Institute had exhausted an edition of 26,000 of its guidance booklet "Careers in the Mineral Industry," by Prof. T. T. Read, of Columbia University, and a revised edition had been printed. Lafayette College had continued its 7-year-old pre-college guidance program for high-school students interested in engineering and mineral technology. The A.I.M.E. Mineral Industry Education Division had sponsored the publication of a 300-page study, "The Development of Mineral Industry Education in the United States." Also, he added, this Division had discusssed at its February, 1941, meeting arrangements which existed in the mineral industries for the progressive development of the young engineer.

In conclusion, Mr. Chedsey asked leave to supplement his report, should one be obtained from his colleagues who had been representatives on E.C.P.D. for several years.

WHAT E.C.P.D. MIGHT DO AND WHAT N.C.S.B.E.E. HAS DONE TO HELP

The report of N. W. Dougherty for the N.C.S.B.E.E. was divided into two parts: (1) What E.C.P.D. might do that it is not doing to make the program of professional development, and (2) what the National Council had done during the year, or plans to do, toward furthering the objectives of E.C.P.D.

Dean Dougherty summarized his suggestions as follows:

1 Determine causes or reasons why students select the different fields of engineering.

2 Accredit graduate curricula.

3 Closer coordination between E.C.P.D. and N.C.S.B.E.E. in the field of professional training. E.C.P.D. is looking toward the right kind of mental activity, N.C.S.B.E.E. is primarily interested in the right kind of experience. Both are needed to develop the young engineer.

4 It might gather information and publish a booklet for students and junior members. "Engineering a Career" is for parents and the beginner. A booklet for professionally orienting students and for directing recent graduates would be a great help.

5 By aiding in securing uniform laws by raising the quality of weaker laws; and by supporting efforts to maintain high standards in their administration.

What the National Council has done was summarized as follows:

1 On professional training National Council has been very active. Emphasis has been placed on qualifying experience rather than education. Studies are being made of examinations as measures of education.

2 On professional recognition a committee has tried to appraise the effects of registration on the engineering profession.

3 The Committee on Legal Procedure has made study of legal practices used in protecting the engineer and the public against the unqualified.

4 What more may be done. (*a*) Assist with the guidance program. (*b*) Revive the Committee on Engineering Education. (*c*) Take a broader attitude toward the young engineer. Boards are not trying to prevent registration; they are trying to see that applicants are competent. (*d*) Cause every member of state boards to thoroughly inform himself about E.C.P.D.

SACKETT ANNOUNCES DOHERTY'S ADDRESS ON E.C.P.D. AT 1941 A.S.M.E. ANNUAL MEETING

In the absence of the A.S.M.E. representative, A. R. Stevenson, Jr., who was to have reported for the Society, Dean R. L. Sackett reviewed briefly what had been done during the year to further the objectives of E.C.P.D. He told how the A.S.M.E. had increased its annual appropriation to E.C.P.D. in common with other constituent bodies and about the joint sessions of the Society and the Council at the Kansas City meeting in June, 1941, under the sponsorship of the Committee on Education and Training for the Industries. Copies of the eighth annual report of E.C.P.D. had been sent to chairmen of the Society's local sections with the request that they study it and transmit questions and comments to the Committee on Education and Training. Articles relating to E.C.P.D. and its work, including President Doherty's report "E.C.P.D. Should Look Ahead,"[2] had been published in MECHANICAL ENGINEERING.

At the 1941 A.S.M.E. Annual Business Meeting, to be held at the Hotel Astor, New York, N. Y. on Monday, Dec. 1, at 2 p.m., Dean Sackett announced, President Doherty would deliver an address on E.C.P.D.

RECOMMENDS MORE PRACTICING ENGINEERS ON E.C.P.D.

S.P.E.E. had had a large part in the activities of E.C.P.D., said Dean Seaton in reporting as representative of the Society for the Promotion of Engineering Education, and this included the services of five members on the E.C.P.D. Executive Committee. He pointed out that on a per-capita basis the S.P.E.E. was making a larger contribution financially than any of the constituent bodies.

Dean Seaton's major suggestion was that an effort be made to appoint a greater number of practicing engineers to E.C.P.D. inasmuch as educators had made up a major part of the Council's membership to date. The services of practicing engineers were particularly desirable on the accrediting committees, he asserted. They were also greatly needed as lecturers in engineering schools and as members of boards of regents and trustees. In some institutions practicing engineers had been helpful in fostering research programs. In his opinion E.C.P.D. should urge participation of practicing engineers in such institutional relationships.

The S.P.E.E., he announced, had limited its institutional memberships to engineering schools whose curricula had been accredited by E.C.P.D., with the exception of Canadian schools where E.C.P.D. accreditation had not as yet been undertaken.

Professional training had been advanced by the schools' participation in the Engineering Science and Defense Training program of the U. S. Office of Education which had an enrollment of 150,000, of whom 90 per cent were engaged in in-training courses. It was his hope that ways would be found to continue this type of adult education of men in industry after the emergency should have passed.

In Dean Seaton's opinion, uniform admission requirements and membership grade qualifications of engineering societies were desirable. He favored the extension of industrial-employment opportunities for engineering-school undergraduates between their junior and senior years and for young instructors of engineering schools. Engineering registration should be promoted also.

[2] See MECHANICAL ENGINEERING, June 1941, pp. 461–463.

In closing Dean Seaton characterized E.C.P.D. as practically the only coordinating agency in the engineering profession.

ANNUAL DINNER SURVEYS E.C.P.D. PROGRAM

The 1941 Annual Dinner of E.C.P.D. was held at the Engineers' Club, New York, on Thursday evening, October 30, with President Doherty acting as toastmaster. Addresses were delivered by N. W. Dougherty, dean of engineering, University of Tennessee, who spoke on "Relation of E.C.P.D. to Registration Boards;" by A. H. White, president S.P.E.E., whose subject was "Relation of S.P.E.E. to E.C.P.D.;" and by James F. Fairman, Consolidated Edison Company of New York, Inc., who analyzed the "Relation of E.C.P.D. to the Engineering Societies."

President Doherty also introduced Dr. C. J. Mackenzie, president of The Engineering Institute of Canada, C. R. Young, dean of engineering, University of Toronto; Virgil M. Palmer, retiring president, N.C.S.B.E.E., and E. A. Holbrook, president National Society of Professional Engineers, all of whom responded briefly.

DEAN DOUGHERTY PRAISES WORK OF E.C.P.D.

Asserting that there must be some idealism in engineering, Dean Dougherty cited the addresses of W. E. Wickenden, "The Second Mile,"[3] before The Engineering Institute of Canada, and that of Vannevar Bush,[4] before the American Engineering Council in 1939, in which it had been stated that "if there is no central organization which had as its creed the best service of the profession to the society of which it forms a part, then there will be in the end no engineering profession."

It was the function of E.C.P.D., he said, to admit desirable young men to the profession and to keep out the undesirable ones, and it was the function of the N.C.S.B.E.E. to cast out of the engineering profession all unqualified engineers who attempted to practice in it.

In the accreditation of engineering curricula, Dean Dougherty pointed out E.C.P.D. and N.C.S.B.E.E. had a common objective. Registration boards had benefited by the accrediting program because they made effective daily use of the list of accredited curricula.

The National Council, he said, had set up a committee on professional training to parallel the E.C.P.D. committee on this subject. It had also inquired into the question, "What is qualifying experience satisfactory to the board?" and had arrived at a definition of the term "satisfactory to the board." In the work of the boards, he continued, it was often difficult to distinguish between "eminent" and "beginning" qualification, and it was the boards' duty to deal with minimum qualifications.

He paid tribute to the E.C.P.D. Committee on Engineering Schools for the effect of its work on the schools, and concluded by stating that E.C.P.D. must secure the same recognition of the value of the work of its other major committees that had been accorded the work of the Committee on Engineering Schools, so that all engineers would feel that they were a party to the E.C.P.D. program.

GROWING IMPORTANCE OF ENGINEERING EDUCATION ACCLAIMED BY WHITE

In speaking of the relation between education and engineering, President White said that the history of the beginnings of the E.C.P.D. deserved to be recorded as the Council had become a coordinating factor in engineering development. The engineering schools, he argued, were like a factory. Partially fabricated material was received, inspected, shaped, tempered, and passed on so that it could be fitted into the organization of the engineering profession. In this process the E.C.P.D. was the "boss" of S.P.E.E. and the colleges, inasmuch as it set the specifications for the college president.

Engineering colleges dealt with adolescent engineers, he pointed out, while the National Council dealt with their admission to the profession. There had been a time when the engineer was called a "roughneck." This was not so today. Engineering had come into its own because it had been recognized that engineers thought clearly from cause to effect. It had been his observation that many arts students did not think clearly and did not work hard. There was too much "do as you please and we hope you will do what is right," and not enough stress on the discipline of accuracy and everyday work.

Engineers must look to the future, he continued. E.C.P.D. had indicated what must be done. Twenty-five years ago engineers had worked 12 hours a day and seven days a week. They had been too tired to engage in other activities. But today, with a 40-hour week, they had time and energy for constructive work, and E.C.P.D. had laid out for them a program for continued growth not only in technical but in cultural fields as well.

FAIRMAN TELLS OF EXPERIENCES ON E.C.P.D.

Making it clear that he was speaking solely for himself and not for the engineering societies, Mr. Fairman developed a "master and servant" analogy of the relations between the engineering societies and E.C.P.D. in which the societies were the masters and E.C.P.D. the servant. He likened the professional development to a beautiful mansion which the masters seldom inhabited but which was well staffed with servants who were accustomed to send an annual greeting to their masters. Apparent indifference of the masters, he said, had led some of the servants to dream about how nice it would be if they owned the masion, so that they forgot their places as servants and became guilty of insubordination. It would be better, he asserted, if the servants were to stop dreaming and get back to their jobs.

When he had been appointed a representative on E.C.P.D., Mr. Fairman confessed, he tried without much success to discover what he was supposed to do. He had attended an E.C.P.D. Annual Meeting prior to his appointment and had been much impressed with the Council and its activities. However, he discovered that he was apparently the "Forgotten Man" and had to find out for himself what to do. He had welcomed the opportunity to comment on the draft of the revised guidance booklet of E.C.P.D., "Engineering as a Career," but even though his comments had not resulted in changes in the text he consoled himself by the thought that he had done his duty. It seemed to be the custom to relax, to look wise, and to say "yes" at appropriate points. During the last year he had succeeded in securing additional appropriation for E.C.P.D. from the A.I.E.E. and publication in *Electrical Engineering* of President Doherty's report, "E.C.P.D. Should Look Ahead." As a result of these experiences he had come to the conclusion that if a specific task was to be done, specific action would be taken.

Turning to what he termed his conclusions, Mr. Fairman asserted that great care should be exercised in the selection of representatives to make up the E.C.P.D. These should be made on the basis that appointment was to a job, not an honor. It must be ascertained that the appointee had time and capacity to do the job. It was a failing of bodies like engineering socie-

(*Continued on page 903*)

[3] Abstract published under title "What Is a Profession?" in MECHANICAL ENGINEERING, March, 1941, pp. 297–299.

[4] "The Professional Spirit in Education," by Vannevar Bush, MECHANICAL ENGINEERING, March, 1939, pp. 195–198.

MATERIAL SPECIFICATION PRINCIPLES

By FRANCIS G. JENKINS

CHIEF, PROCUREMENT SECTION, WATERTOWN ARSENAL, WATERTOWN, MASS.

SINCE more money is spent on materials by the average manufacturer than on machinery and labor together, it follows that the scientific handling of the material supply function through material standardization is of utmost importance. It should be emphasized that the degree of efficiency and economy resulting from standardization depends to a large extent upon the completeness and accuracy of the material or purchase specifications as developed and maintained. The trend, therefore, in specifications has been toward a precise statement in measurable terms of the magnitudes of the pertinent properties and dimensions which determine the utility of the material.

The establishment of material standardization, including the preparation of material specifications, results in more than bringing the user and the maker together in a clear understanding of the quality of service. Standardization has also effected a noteworthy saving in time, money, and convenience, and has concurrently raised the average quality and reliability of the product.

In the limited sense in which it is used in this paper, a material specification is the medium for expressing a material so that it may be clearly understood by the vendor, the buyer, the inspector, and the user. In the main, purchase specifications are simply complete systematically written descriptions of the material to be purchased, sufficiently accurate and definite to insure receipt, at the least cost, of the quality required for satisfactory use.

Consumer purchase specifications are prepared and utilized as a supplement to technical-society or government-bureau specifications, since the use of the latter within company organizations ordinarily involves some interpretation or condensation. National specifications, because they are meant to cover the needs of a whole range of industries, are of necessity highly generalized, treating types, grades, finishes, tolerances, and other properties so comprehensively as to be unsuited for the particular requirements of a single company. Furthermore, they obviously cannot cover at all individual company instructions for packing, marking, and rejection. Another important reason for the preparation of company specifications involves the identification of materials on drawings, correspondence, and records by the company's material symbol.

REQUIREMENTS

Basic Considerations. In the selection of a manufacturing material standard and the preparation of the purchasing specification, the governing considerations are ability of the material to meet service requirements, ease of working in the manufacturing process, uniformity, availability, and first cost. The emphasis in specifications should therefore, whenever possible, be upon satisfactory performance in service and in fabrication, rather than upon method of manufacture, chemical composition, and physical properties.

First cost is a subordinate consideration in nearly every case. As a general rule, where expensive labor is engaged to work up or finish purchased materials, it is the part of wisdom to establish a somewhat wide factor of safety of quality for that material. This is true because the first cost of the material is a comparatively small item in the cost of the finished product. It is sometimes necessary, however, to select and specify a material which does not come up to what is desired for its particular purpose, but which will serve nevertheless and which must be chosen because of the lower cost which it involves.

Exact. All requirements of a specification should be definite and exact by using numerical expressions of values and therefore be verifiable by measurement or comparison so as to leave as little room for misunderstanding as possible. The degree of exactness with which the requirements of a specification are formulated determines the latter's effectiveness as a guide leading toward agreement between the antagonized interests of both the producer and the consumer. It should be mentioned, however, that under some circumstances, where nothing better is available, unspecific clauses may be of value in giving the producer a better idea of the material desired, or by drawing attention to an item to be given special consideration.

To be specific is sometimes difficult, since numerical data may not be available, or since many properties and characteristics of importance do not lend themselves readily to accurate and, at the same time practical, definition. For those considerations that are not capable of adequate definition it is possible to say that the shipment shall be equal to a given standard sample. Samples of such commodities must be received from the vendor and tested, and the sample must be retained for checking deliveries. Though the use of a standard sample is an unsatisfactory method of specification, it is sometimes the best that can be had until the qualities concerned can be reduced to a basis of adequate expression.

Standard. Consumer specifications should be formulated on the basis of the foundation laid down by the technical-societies' or by the governmental-agencies' specifications. Where practices of standard specifications vary over a large range, an effort should be made to follow the main path of common practice, if thereby economy and utility do not have to be sacrificed. In cases in which there are no national specifications covering the material desired, original specifications are prepared based on material which has proved satisfactory in use and which deviates to the least possible extent from general commercial practice and the capabilities and limitations of the supplier.

The advantages obtained by the use of specifications that are recognized as standard throughout the country are, of course, much greater than those obtained by the use of specifications that are standard only within the plant of a producer or a consumer. The national standard is evolved as a result of the collective work of the leading experts on the subject and as such is more valuable than might be the selection of any individual. Furthermore, by utilizing a standard specification, the advantages of simplification are secured. By concentrating attention on one standard material of a kind, production on

the part of the manufacturers is permitted in larger quantities at lower cost, and better facilities are afforded for manufacturing, inspection, and testing. Thus is provided the highest quality of material as well as the most uniform product, minimum cost, maximum availability, and maximum competition.

On occasion the requirements for any one special material may be so great in quantity and the conditions of its use so extraordinary as to warrant its procurement and use even though it is not an accepted standard. Such instances should be carefully considered, however, since frequently the actual advantages gained are insufficient to outweigh the disadvantages resulting from the purchase and stocking of items, the uses for which are limited to certain specific services.

Equitableness. Next in order of importance come those qualities concerning the vendor's interest in the material specification, which are reasonableness, fairness, and impartiality. The producer should be given the greatest latitude in furnishing material for the purpose desired. Though specifications should be so comprehensive as to leave no chance for ambiguity, it is also important that the specification should have the fewest requirements consistent with securing satisfactory material. Requirements that are not practical, those that specify special items which add nothing to the specification value, and those that are not sufficiently understood and recognized to be stable are all undesirable features.

Specifications should be reviewed by the producer, who is especially helpful in determining whether they are practicable from his standpoint. Unnecessarily severe requirements that cannot be carried out regularly and uniformly react to the disadvantage of both the producer and the consumer, for such requirements are likely to increase the cost and interfere with production by delaying shipment. Recognition of the vendor's point of view is not only advisable as a matter of fairness to the vendor but also as a probable essential in securing the supplier's cooperation and in making the specification effective. No amount of specifications can replace mutual respect and good feeling between vendor and buyer.

Numerical Limits. Even with the best of facilities and with careful and skilled workmen, exact duplication of form and size as well as physical properties and chemical composition is not an easy matter. Consequently, in practice it is required that any essential item stated in terms of measurement in a specification be covered by a tolerance allowing for deviations from the exact nominal value.

It is a principle of good engineering from the combined viewpoint of technical effectiveness and economic production to use the largest commercial tolerances compatible with good performance of the product. The tolerances at all times should be wide enough to accommodate uncertainties of chemical and physical methods of tests and inaccuracies of result. The consumer is primarily interested in limits, such that uniform material is assured that will be satisfactory in service and that will process satisfactorily and uniformly in the shops. Uniformity of treatment in heat-treating, machining, forging, and welding, for example, is oftentimes the only determinant of the limits. In this connection special care must be taken that the specification does not overspecify by requiring material which is too good for the buyer's purposes. Variations that may be permissible will differ greatly with the character of the service, for in rough work considerable latitude may be allowed in workmanship, properties, and dimensions. Tolerances should not exclude competition and commercial materials by including requirements that are written around one particular brand. Composition ranges for tool steels, for example, should be sufficiently wide to include in any one group most of the trade-name brands which are intended to be similar and yet sufficiently restricted so that heat-treatments, applications, and general characteristics are identical within the group.

In general, reduction in tolerances increases the cost of manufacturing and may needlessly antagonize the producer, limit the number of available sources of supply, restrict competition, and increase the cost of the material and the time required for testing.

Certification. The manufacturer sometimes will furnish a certified statement that he has tested and inspected the material and that it meets all the requirements of the specification. Such a certificate of guarantee is generally accepted by the buyer as evidence of satisfactory delivery. More often, however, the vendor is willing to supply only a certified heat analysis of the material. In the event that a certificate is found to be contrary to the results of check tests, the material is rejected and the matter called to the attention of the vendor. Repeated failures of this nature result in the removal of the vendor's name from the acceptable sources of supply.

It is claimed that the certificate plan in many cases has greatly reduced the amount and cost of testing. The importance generally attributed to these guarantee clauses is, in the author's opinion, often exaggerated. In the first place, in using such clauses it is necessary to ascertain that they are not obviously exclusive. If certain guarantees are stipulated specifically, it might be assumed that other requirements which are not so stipulated are not guaranteed. However, the principal consideration in this regard is the fact that most American business is based more on mutual trust and a mutual desire to continue doing business than it is on any written record. Very seldom does the manufacturer refuse to make good on material which is found later to be faulty, whether there was a specific guarantee or not. And in neither case will the manufacturer broaden his liability to include the cost of interrupted fabrication and service caused by the faulty material. Furthermore, in general, careful inspection and testing of material are necessary to insure proper deliveries under any specification.

COMPOSITION

Clarity. The specification should be as simple as possible. The requirements should be made, as far as possible, mutually exclusive, by which is meant that no part of the work should be specifically described in more than one place. Repetition of descriptions tends to weaken the document.

The specification must concisely and clearly state what the purchaser desires by describing or specifying accurately the material or the properties required in standard terminology. While brevity and conciseness is desirable, it should be sacrificed where necessary in favor of clarity and completeness. This is a protection to the vendor and buyer alike, for misunderstandings are expensive to both. Specifications, especially, should be so drawn up as to make it unnecessary for the vendor to request additional information.

It is assumed that the greatest care will be given to such matters as grammar, composition, and selection of words in the preparation of specifications. The technical terms or vernacular common to the trade to which the specifications apply may be used but they must be understood and used correctly. Attention also should be given to correct punctuation and spelling to avoid misrepresentation. The use of pronouns, especially of relative pronouns, should be reduced to a minimum. It is better to repeat the noun even at a sacrifice of elegance.

Standardized Form. A specification written in conformity with standard form tends to eliminate confusion on the part of all who handle it, as similar requirements are always in the same place. Such a complete and definite form of presentation is furthermore a distinct asset to the specification writer, since the form itself acts as a guide and often indicates certain details to be included that, ordinarily, could be easily overlooked. A

logical arrangement of the details also is an important factor in clearness.

The form in general should be compact, with every paragraph identified with a number or letter and a suitable heading.

Consolidation. It is advisable to prepare specifications the scope of which is as comprehensive as possible. The so-called consolidated specifications incorporate several grades, sizes, tempers, and the like of one broad class of material wherever that may advantageously be accomplished, identifying each by a numerical suffix. Usually such consolidation is made on the basis of similar composition. Consolidation should not be carried so far, however, that, in order to cover properties for all contingencies of use of the material, undue complication results.

In the process of consolidating specifications, increased opportunities are presented for eliminating all unnecessary variations in type, form, or size and limiting the use of all similar materials. Also the use of consolidated specifications by eliminating the repetition of dimensions, ratings, and general instructions, and overlapping varieties requires only a portion of the paper covering the single specifications. The greatly reduced number of papers to be handled and recorded thus requires less clerical effort and aids in reducing mistakes.

Specification Symbol, Date, and Designation. The first item appearing at the head of the specification is a symbol consisting of appropriate figures, letters, or signs. These characters, selected in harmony with the arbitrary company material classification, definitely establish and describe the material, thus eliminating the old confusion of many different names.

Approval and effective dates follow which are very important in order to avoid possible confusion caused by the unintentional use of a specification obsolete through revision.

The title or designation should be clear, as brief as possible, and understandable to the layman. It should be set up in directory or index style in which each important word is capitalized. In selecting the title or the name of a standard, the purpose should be to give an accurate and adequate conception of the matter described in the specification. Titles having the maximum self-explanation are desired. While brevity and conciseness are also desirable it is better to err on the side of using too many words, if by so doing misunderstanding of the title can be prevented.

Arrangement. The author has found the following practice quite satisfactory: The principal sections in each specification are grouped under suitable headings. These headings appear in capitals, are underscored, and may be designated by upper-case arabic numerals, numbered consecutively. Subsections within a single section are preceded by subheadings which are capitalized and underscored and are distinguished by lower-case letters in parentheses. The subheading lettering does not run consecutively throughout a given specification but begins with (*a*) in each section.

The requirements are grouped in general under the following section headings in the sequence indicated:

Scope. Applicable requirements. Manufacture. Chemical requirements. Physical requirements. Form and size. Size tolerances. Packing. Marking. Rejection.

Sections that cannot appropriately be placed under any of the foregoing headings are grouped under special headings inserted in their most logical position. Such special subheadings should be indicative of the contents of the sections to which they pertain. The use of such subheadings as "General" and "Miscellaneous" is to be avoided.

CONTENTS

Scope. The first section with the heading of "Scope" serves as an index to the subject matter of the specification. It should be noted that such terms for the heading as "Introductory" and "General" are lacking in definite meaning and may in some cases be wholly inappropriate. The section begins with a brief but clear general description of the desired material covering the types, grades, tempers, and sizes included in the specification. Then follow reference to the equivalent national standard specification and information as to whether it has been followed without change of technical requirements or with slight deviation. An explanatory statement that will help the manufacturer to understand the material's intended uses should be incorporated and likewise reference to any processes to which the material is to be subjected, if the process is at all likely to affect the quality of the material.

Applicable Requirements. In this group, reference should be made to any applicable specifications, general requirements, or drawings forming a part of the specification or which must be considered to permit a complete interpretation of the specification.

Any subsection heading should be indicative of the content of the subsection to which it pertains. For instance, the subsection heading "Material" calls attention to a specification covering the material from which the article is fabricated. Other possible subsection headings are designated by appropriate titles such as "Code List" or "Layout Sketches."

Manufacture. This section covers both manufacturing methods and quality under the following subsection headings:

"Material" concerns a description of necessary requirements relative to the character or quality of the materials used. This subsection should be drawn up bearing in mind that the importance of raw materials as a quality determinant always depends upon the degree to which deficiencies and lack of uniformity may be corrected within the plant.

"Process," "Heat-Treatment," and "Welding," together with any one of a number of other subheadings, designate the method of producing and treating the material by the manufacturers.

"Edge" and "Finish" concern a description of any standard or special edge and finish requirements.

"Workmanship," "Structure," and "Soundness" involve a description of the uniformity, soundness, nature of the surface, and other qualities desired. In the modern plant workmanship refers to the efforts of all the workers, the equipment which they use, and even the environment in which they work.

Chemical Requirements; Physical Requirements. In these two separate sections, all items listed under "Scope" should be considered, detailing respectively for each those chemical and physical requirements, characteristics and descriptions as may be necessary to define the material required.

These sections should also include such descriptions of new and not too well-known methods of tests and analysis or even well-known standard methods where different methods give different results, as may be necessary to insure that the tests will be properly conducted and to prevent doubt and ambiguity. Where methods of testing, analysis, or inspection are well known and understood, it is sufficient if the specification simply refers to them.

In addition, it is often necessary to include methods of sampling to insure representative samples because the values obtained for the properties mentioned may be affected by the method employed. Any other necessary instructions as to inspection should be given for the guidance of both the inspector and the producer.

The "Chemical Requirements" subsection headings include chemical composition, ladle or heat analysis, sampling, and the like.

Form and Size. This section covers the form of the material and the size, including length, weight, coil diameter, and the like, which are acceptable. In a factory where storage space and machine room are limited, it is often out of the question to

accept bars above a certain length, as they would have to be cropped short prior to storing or machining, thus necessitating an extra operation and probably modifying the estimated cost figure. Also outlined in this section are those dimensions which must be specified on the purchase order.

Size Tolerances. Size tolerances, as applied to raw materials, may be defined as the permissible or allowable variation in a dimension of a part equal to the difference between the minimum and maximum limits. This permissible variation is ordinarily expressed in terms of either bilateral or unilateral tolerances. By bilateral is meant permissible variations in either direction from a specified size, while by unilateral is meant permissible variation in one direction only.

In general, where the dimensional tolerances are of little interest, such as on hot-rolled sheet and bar, it is sufficient to state that the material shall comply with the manufacturer's standard tolerances. In instances, however, where the tolerances are important, even though they may be standard, it is necessary to list them in the specification. Thus the exact requirements are identified with the material and are presented for the ready-reference of buyer, vendor, and the raw-material inspection department.

Packing. This section assures receipt of material in a form suitable for convenient handling and reduces the possibility of receiving goods in a damaged condition. The scope of the packing section varies according to the nature of the material. It is often limited to a statement that the material shall be packed in such a manner that it will not be damaged in shipment, though frequently specific packing methods are described. In the latter case, material may be required to be boxed, burlapped, or strapped to skids as well as being properly separated by grade or size when loaded for shipment. Bright-surfaced materials usually demand special instructions as to suitable separators and wrapping. If a rust preventive is desired, it is noted that all material shall be suitably oiled for protection against corrosion.

Information may be given on the method of loading in carrier trucks or freight cars as well as the allowable weight for box, bundle, or skid. When the material is packed on skids information should be supplied as to the type, dimensions, and construction of the skid.

Marking. In this section should be described the manner in which the material is to be marked and also the marking which should appear on the containers before shipping. The marking should of course be such that there will be no difficulty in identifying the material and applying it to the order on which it belongs and thus tie it up to the invoice received by the purchasing and accounting departments.

On many materials, the mills and warehouses are only too willing to cooperate by marking or painting the material before shipment at no cost. Tool steels are furnished by the vendors with the purchaser's specification number and a symbol indicating the manufacturer legibly stamped on both ends of every bar having a cross section large enough to accommodate them. The practice of color identification is more or less general in the trade and consists of painting at least the ends of the bar and the full lengths of the more expensive materials such as tool steels.

Rejection. This section consists primarily of a statement that any material not complying with the regulations and limitations as presented will not be accepted. It is felt justifiable, after formal acceptance by the producer, to insist that the specification be met in every respect and to reserve the right to reject material which fails to meet the requirements. There are, of course, sometimes mitigating circumstances which warrant permitting some leeway.

Any provisions for the disposal of rejected materials should be included in this section. In some cases the material may be paid for as of a lower grade; in other cases rejections are to be accumulated and periodically examined by the vendor at his expense; and in still other cases, the vendor agrees to be liable for time expended or damages incurred as the result of the failure of the materials, although this is not a common provision.

SELECTED BIBLIOGRAPHY

1 "The Making of Specifications for Structural Materials," by C. B. Dudley, Trans. A.I.M.E., vol. 21, 1893, pp. 379–394.

2 "The Making of Specifications for Materials," Presidential Address, by C. B. Dudley, Proceedings A.S.T.M., vol. 3, 1903.

3 "The Enforcement of Specifications," by C. B. Dudley, Proceedings A.S.T.M., vol. 7, 1907.

4 "The Purchase of Materials on Specification," by D. Harvey, Proceedings A.S.T.M., vol. 25, part 2, 1925, pp. 425–441.

5 "Specifications From the Standpoint of a Large Purchaser of Engineering and Special Materials," by J. W. Bancker, Proceedings A.S.T.M., vol. 31, part 2, 1931, pp. 987–995.

6 "The Standardization Work of The Detroit Edison Company," by F. M. Price, American Standards Association, *Bulletin*, vol. 3, nos. 2, 3, and 4, Feb., Mar., and April, 1932.

7 "Some Fundamentals in Standardization," by F. B. Jewett, *Industrial Standardization*, vol. 8, Dec., 1937, no. 12, p. 323.

8 "N.A.P.A. Handbook of Purchasing Policies and Procedures," vol. 1, National Association of Purchasing Agents, New York, N. Y., 1939, chap. 4, "Buying the Proper Quality."

9 "Material Standardization," by F. G. Jenkins, *Iron Age*, vol. 147, Feb. 20, 1941, no. 8, pp. 35–39, and vol. 147, Feb. 27, 1941, no. 9, pp. 52–55.

E.C.P.D. Hears Members' Views

(*Continued from page 899*)

ties to assign too many jobs to the same man, on the theory that a busy man had the most time, but he for one felt that there was a limit to the wise application of this theory.

Officers and directors of participating bodies, he declared, should review what they were getting for the money contributed to E.C.P.D. He criticized the practice of setting up new organizations to handle new tasks on the theory that a new group would best do the job, when, as a matter of fact, he said, continued interest and sustained effort were essential.

To representatives of participating bodies he suggested that they examine their own consciences and ask themselves whether they had time and capacity to take on the tasks assigned them. Furthermore, he added, they should resign if they found they could not give the business called for by their appointment the attention it demanded. Their attitude should be not to ask the sponsoring bodies what they thought about the problems of E.C.P.D. but to tell those bodies what the representatives thought and what should be done. In making recommendations the representatives should be of one mind. They must see their tasks through themselves and not put them off on other committees.

Definite assignments were essential to progress and success of E.C.P.D., Mr. Fairman said. The Council had adopted policies in October 1933. Did we find all the answers in 1933, he asked, or had we become discouraged and lost heart. What effective action had been taken on the recommendations of E.C.P.D.'s committees? If those recommendations were not effectively implemented by the engineering societies, some other group would take them over. The Committee on Student Selection and Guidance had been stimulating local sections to do something about the problems in the field of the committee's interests. What had been done? he asked. Model registration laws should be taken out of the realm of theory into the realm of practice; they must yield to fact and not to fancy.

In conclusion, Mr. Fairman emphasized again the statement that he was expressing his personal opinions and not those of any group and his conviction that "we are not doing what we might do."—G.A.S.

THE SHIFTING CONTROL OF INDUSTRY[1]

By DWIGHT L. PALMER

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

TO conceive a simple, straightforward theory into which to fit the apparently chaotic episodes of contemporary world events is no mean achievement. When an author undertakes this difficult assignment and moves with consummate skill and dexterity in meeting his own challenge, his ideas are surely noteworthy.[2]

James Burnham is such an author, and his provocative thesis can be bluntly summarized at the outset: Any society comes under the dominant leadership of those of its members who can most effectively control its instruments of production. In our capitalist world, with its very foundations shaken by persistent employment of men and productive capacity, the former capitalist controllers are fast losing their old-time power. But no classless Utopia is imminent. Instead, control shifts to a new ruling group composed of the bureaucrats and government officials into whose hands is passing *real* power over production. This group—the "managers"—like their capitalist predecessors will hold the reins of power, reserving for themselves the usual plums which are the reward of dominance. And the masses, formerly won into supporting capitalist leadership by identifying their welfare with that of their employers, will be cajoled by another set of slogans and rationalizations into supporting their new directors. A major social transition is accomplished in the birth of a "managerial" society.

Each of the author's five main assertions must be summarized in turn before we can rationally evaluate the main thesis.

1 *Capitalism as a Way of Life Is Dying.* By a "way of life" the author means that social and economic system of individual and institutional functioning which constitutes a particular society. Running through the varied kinds of society which man has evolved, three elements commonly occur:

(*a*) A productive system.

(*b*) Social classes differing in their access to, and control over, this productive system, both as to its technical operation and as to the distribution of the goods it produces.

(*c*) A system of beliefs and socially accepted rationalizations by which all elements of the whole society, no matter how involved in or excluded from control or "spoils" or both, come to support the status quo. As the author puts it: "Ideologies capable of influencing and winning an acceptance of great masses of people are an indispensable verbal cement holding the fabric of any given type of society together."

For example, capitalist society comprises two broad economic groups—the capitalists, owning and controlling the instruments of production and giving themselves, according to the author, "disproportionate" rewards for their administrative efforts; and the workers, doing the capitalists' bidding and, through a system of slogans and rationalizations, identifying themselves and their interests with those of their "bosses." The capitalists, in short, have been a "ruling" class.

Of late, however, the capitalists, i.e., owners, more and more withdraw from contact with the productive process or from serious, direct control over the industrial machine. And capitalism appreciably weakens as capitalists vacate factory and office for beach home and yacht. For, "to rule society . . . is a full-time job."

Furthermore, an even more challenging change has taken place among noncapitalist groups. Any social ideology is successful only so long as it supports the ruling classes *and* appeals to the masses. Capitalist slogans still meet the first test, but Burnham stresses that increasingly they are failing to meet the second.

In one telling paragraph the author summarizes his analysis of capitalist decline. "The United States, certainly, has not escaped mass unemployment nor permanent agricultural depression nor colossally growing debt nor idle capital funds nor the inability to utilize technological possibilities. If the reduction in the area of private enterprise in the total economy is as yet behind that in Russia and Germany, the tendency and direction are no less unmistakable. As in other nations, the reduction is twofold in character: An ever-greater percentage of enterprise is conducted outright by the state, and to an ever-firmer extent the rest of enterprise is subject to state control."

2 *Socialism in the Contemporary World Is Impossible.* As Burnham argues, socialism (connoting a fully democratic, classless society) is an extremely unlikely successor to capitalism. In a world like ours the intricate techniques of production increasingly separate the planning and controlling group from the workers on their assembly lines. And, as always, such a technical cleavage of function is reflected in the social class structure. Russian experience with worker "control" is cited as additional evidence against the immediate likelihood of the elimination of industrial "leadership." The capitalists, lacking their old drive and vigor, and withdrawing increasingly from the factory, lose control of the productive system. Here is capacity without contact. The workers, on the other hand, although they are immersed in the details of industrial life are unable to control it. Here is contact without capacity. Hence, there emerges by default a new dominant class into whose hands the control of society is shifting.

3 *A Group of Technicians and Officials (the "Managers") Is Assuming Control of Our Productive Processes.* There is arising a new managerial type, the bureaucrat, whose function is to organize effectively the productive system, through government regulations, state rules, and administrative edicts. Congresses and parliaments, once the bulwarks of capitalism's private property rights, relinquish ultimate, effective control of industry to these technically trained, efficient state functionaries. As the author describes this process, "a state which is building roads and steel mills and houses and electric plants and shipyards, which is the biggest of all bankers and farmers and movie producers, which in the end is the corporate manager of all the major instruments of economic production, can hardly be run like the state which collected a few taxes, handled a leisurely diplomacy, and prosecuted offenders against the law. Nor can the same kind of men run it."

4 *The Managers Are Coming to Power Through a Major Social Transition (the "Managerial Revolution").* This transfer of power from one social group to its successor, when accompanied by appropriate shifts in institutional organization, constitutes

[1] One of a series of reviews of current economic literature affecting engineering prepared by members of the department of economics and social science, Massachusetts Institute of Technology, at the request of the Management Division of The American Society of Mechanical Engineers. Opinions expressed are those of the reviewer.

[2] "The Managerial Revolution," by James Burnham, The John Day Company, New York, N. Y., 1941, 285 pages.

what is called a social revolution. Two elements are usually involved in such a major transition: First, the former (now outmoded) dominant class must be superseded. Burnham argues that this is rapidly being accomplished, for example, through such state activities as the outright taking over of an economic function, as in the TVA, or through a widened state control, as in security exchange policing. Second, there emerges a new dominant group capable, on the one hand, of controlling the productive machinery, and, on the other, of defending itself and its new power, usually through the winning of wide popular support through convincing the bulk of the people that the new dominant class represents their interests as well as its own. In regard to timing, the author insists that the major "managerial revolution is not just around the corner . . . The corner of the managerial revolution was turned some while ago."

The easiest road to power for the new control group today is a dictatorship. But, "it should be noted that a totalitarian type of dictatorship would not have been possible in any age previous to our own. Totalitarianism presupposes the development of modern technology, especially of rapid communication and transportation. Without these latter, no government, no matter what its intentions, would have had at its disposal the physical means for coordinating so intimately so many of the aspects of life." Accordingly, it would seem that the first stages of managerial control will be predominantly nondemocratic in nature. In the long run, however, certain democratic aspects may persist or even expand. For example, some limited forms of democracy such as elected advisory committees or public forums may enable the managers more readily to understand the general public and, in addition, provide a good safety valve through which opposition elements may blow off steam without upsetting the apple cart.

5 *The Managers Will Establish a New Form of Economic Organization (the "Managerial Society").* The elements of capitalism's successor (some of them already visible) may be enumerated. Private ownership of the means of production is superseded by state control operating through a corps of technically trained bureaucrats. These "managers" will operate or control the major elements of the production system with one eye on technical efficiency and the other on assuring themselves a generous compensation for their efforts. A new set of myths and slogans will facilitate these shifts by identifying, at least in the public's mind, its own interest with that of the new dominant class.

. . . . . .

So provocative an analysis of contemporary America renders critical evaluation extremely difficult. The tremendous intellectual drive of the author's argument makes it seem almost carping to dwell upon matters which, important in themselves, are but minor segments of his inclusive thesis. Nevertheless, three types of comment demand presentation. First of all, there is the matter of assumptions. It is immediately clear that Burnham as an economic determinist rather tacitly assumes that his readers acquiesce. To those who do not agree that the methods whereby men get their livelihood basically determine social living, the whole book is obviously a phantasy.

Although the conception of social revolution is carefully defined, no elaborate argument is offered to prove that today, in very truth, we are undergoing a revolution rather than a period of excessively rapid social change of the type characteristic of all dynamic societies. Again, the reader cannot but note the almost casual way with which the author dismisses genuine democracy as being impossible in this "historical epoch" of world history. To an American audience this major element of our national thinking deserves more careful analysis. These underlying assumptions may alienate many readers.

In addition to assumptions, there are certain points in the argument itself which may be difficult to accept. The abandonment of a price system seems to involve us in difficulties not completely visualized by our author. For example, he says, in discussing Germany and Russia and their productive capacities, "Here again, we are not concerned with *what* goods are produced, but with the volume of production relative to population and potential capacity." If this is taken at its face value it follows that if America disregarded money symbols and used only tons, and if we devoted our entire production capacity to producing bricks and cement, we could increase output 500 per cent and starve to death within a month. To the consumer, *what* goods are produced constitutes the essence of the economic problem. The long-run satisfaction of consumer wants (presumably bound up in the author's own acceptance of historical materialism) is surely not so obviously furthered by such crude decision making that analysis is unnecessary.

Again one wonders whether stating that only three alternatives confront the world is not more appealing in its simplicity than in its realism. The reading of world history perhaps suggests that in a society of complex institutional forms such simply forked roads seldom present themselves. Some readers may feel, for example, that the trained technicians who in the absence of the owners increasingly control corporate enterprise may prove more than a match for the state bureaucrats in the current struggle for power. Capitalism, seeing the handwriting on the wall, may through some such device yet prove itself possessed of surprising resilience and reserve strength.

Despite such moot points, and notwithstanding the hesitancy with which some readers may accept the author's basic assumptions, the incisiveness and driving force of Burnham's total argument is "good medicine" intellectually. The reader is almost inescapably forced to re-examine his own thinking in an effort to find an equally, or possibly an even more, watertight explanation of contemporary world events. And whether one concludes that we are experiencing a social revolution or merely social change at a terrifically accelerated rate, one is squarely confronted with the vital question of our socially dominant class—their training, their goals, and their methods of control. On this issue the author has presented a brilliant interpretation which may serve as confirmation to those who agree and a powerful, challenging, counterstimulus to those who may feel driven to differ.

Need Naval Ordnance Materials Inspectors

IN June the U. S. Civil Service Commission announced that it was recruiting inspectors of naval ordnance materials. Appointments are being made at the Washington, D. C., Navy Yard, Naval Torpedo Station in Alexandria, Va., and at various contractor plants in the field. The examination announcement covering these positions has just been issued in revised form, covering positions paying from $1620 to $2600 a year and such optional branches as optical and fire-control instruments, naval guns and accessories, munitions, and ordnance units.

The need of the Navy Department for Junior Inspectors ($1620 a year) is particularly pressing.

No written examinations are given for any of these positions. Applicants are being rated on their education, training, and experience as shown in their applications. Anyone under 65 years of age qualified in any of the several fields connected with this work is urged to apply. Applications will be accepted until further notice. Interested persons can secure the form Announcement No. 95-Revised from any first- or second-class post office, or from the U. S. Civil Service Commission, Washington, D. C.

BRIEFING THE RECORD

Abstracts and Comments Based on Current Periodicals and Events

MATERIAL for these pages is assembled from numerous sources and aims to cover a broad range of subject matter. While few quotation marks are used, passages that are directly quoted are obvious from the context and credit to original sources is given.

Million-Volt X Rays

VARIOUS SOURCES

MILLION-volt X rays, until recently obtainable only with elaborate equipment and used in a few hospitals for cancer treatment, have been made available to industry in portable apparatus and are being used to speed defense efforts at several large plants.

The story of million-volt X rays, their applications, and their possibilities, was told jointly at a recent symposium by E. E. Charlton and W. F. Westendorp of the G-E Research Laboratory, who described the construction of the X-ray equipment; C. D. Moriarty of the G-E Schenectady Works Laboratory, who explained the application of million-volt X rays in the examination of large castings; O. R. Carpenter of The Babcock & Wilcox Company and A. J. Moses of Combustion Engineering Company, Inc., describing the application of 1,000,000-volt X rays in inspecting boiler drums and pressure vessels, and comparing million-volt and 400,000-volt use; Donald McCutcheon of Ford Motor Company emphasizing aluminum investigations; and E. W. Page of the General Electric X-Ray Corporation, who pointed out some of the other industrial applications of X rays.

The million-volt outfit will photograph through 5 in. of steel in 2 min, Dr. Charlton explained. A 400,000-volt tube, the next size smaller, requires $3^1/_2$ hr to do it, and does not show nearly as much detail through these thicker sections. Thus the new apparatus speeds inspection of parts for vital defense machinery. It is being used regularly in Schenectady to test large castings. Extensive industrial use is made possible by the compactness of the design. The tank is 3 ft diameter by 4 ft. Including the cooler and 2-ft extension chamber the overall height is 7 ft. The weight is 1500 lb. These extremely small dimensions and the low weight—smaller and lighter than any equipment previously built for even 400,000 v —have been made possible by three novel developments.

The first one is the use of Freon gas under pressure as an insulating medium in place of oil. At a pressure of 50 lb, Freon 12 has a dielectric strength three times as great as the purest transformer oil. The breakdown values of Freon are consistent, whereas oil is erratic. The heat-transfer problem inherent in gas insulation was solved by means of a small cooler which consists of a $^1/_{15}$-hp fan circulating the Freon gas over finned water-cooled copper tubing and through the transformer. At low ambient temperatures, such as may occur in industrial plants in winter, the Freon must be kept at summer temperature by electric heaters to keep it from condensing on the tank walls.

The second novel development is the use of a resonance transformer without iron core. All users of high-voltage equipment operated on alternating current are familiar with the charging current. In the ordinary transformer this current serves no directly useful purpose but is a necessary evil since it serves to reverse the potential of the high-voltage terminal of the equipment, which has a considerable capacity to ground. In the resonance transformer this charging current has been put to good use: It is made to flow through a large inductance coil without iron core and thereby it produces exactly the high voltage required. In other words, the inductance of the coil and the capacity of the high-voltage terminal have been chosen to tune at the frequency of the power supplied to the transformer. By the application of a small amount of power to a thin flat primary coil placed underneath the high-voltage inductance coil, the resonant system of coil and capacity

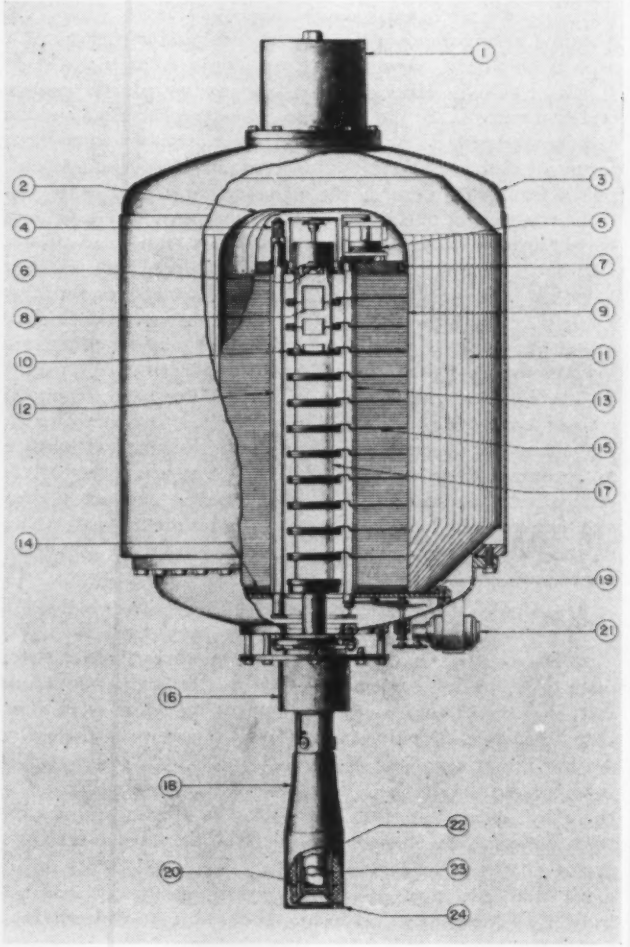


FIG. 1 SECTIONAL DRAWING OF 1,000,000-VOLT X-RAY UNIT
(1 Cooler. 2 Slotted brass shield. 3 Steel tank. 4 Spring for the rod. 5 Variable reactor. 6 Cathode assembly. 7 End turn filament coil. 8 First intermediate electrode. 9 Secondary coils. 10 Shields around the X-ray tube. 11 Laminated shield. 12 Glass tie rod. 13 Insulating filament control shaft. 14 Primary winding. 15 Tap lead. 16 Focusing coil. 17 Glass envelope. 18 Lead shield. 19 Laminated steel bottom. 20 Tungsten target. 21 Filament control motor. 22 Water jacket. 23 Extension chamber. 24 Lead diaphragm.)

Courtesy Babcock & Wilcox Company

FIG. 2 RADIOGRAPH OF WELD IN STEEL $4^1/_2$ IN. THICK
(Showing standard penetrameter, marked 45, in accordance with A.S.M.E. Boiler Code.)

can be made to swing up to one million volts. The high-voltage coil is 30 in. high, 18 in. outside diameter, and 8 in. inside diameter, and consists of thin coil elements stacked on top of each other. The high-voltage terminal on top of the transformer is a rounded brass spinning $6^1/_2$ in. high and 18 in. in diameter. As mentioned before, no iron core is needed inside the coil. This simplifies the insulation problem and reduces the tank diameter to two thirds of that required for the conventional transformer. The space inside the high-voltage coil has a very uniform voltage gradient, as the million volts are distributed over the 30-in. coil-stack height. This uniform gradient makes possible the use of glass rods as mechanical tie-rods to hold the stack together, thereby allowing operation in any position. Each of the seven rods is tested at 1500 lb tension and spring-loaded to 500 lb in the transformer assembly. An eighth rod serves as the filament-control shaft.

The power frequency chosen for resonance is 180 cycles per second from purely practical design considerations. A synchronous motor generator is used to maintain the frequency accurately and to eliminate the effect of line voltage fluctuations. The power required to operate the outfit at 1000 kv and 3 ma is approximately 4 kw.

The third novel development is the sealed-off multisection X-ray tube because it does not require a vacuum pump and its location in the center of the high-voltage coil does not increase the size of the tank.

The X-ray tube has twelve sections. Electrons to produce the rays emanate from a heated filament at the top. As they pass through each section, a voltage of about 84,000 is applied, giving them an added push. By the time they reach the bottom, they have been boosted by a total voltage of a million. Then they hit a tungsten target, in an extension of the tube which projects from the bottom of the tank, and X rays result.

Unlike the small tube, where the X rays come off at right angles to the electron beam, most of the million-volt rays pass through the target and emerge in the direction in which the tube is pointed.

Consequently, in most industrial uses, the tube, and the tank with it, is aimed like a gun at the casting to be examined, and the X-ray film is fastened to the other side. When it is more convenient, however, pictures may be made with the rays that come off to the side.

It is the economy of the million-volt X-ray equipment, as compared with smaller units, that makes possible routine examination of steel castings, according to C. D. Moriarty, in charge of the equipment used in the General Electric laboratory.

For some years, he said, factories have made routine examination by X rays of all welded parts to test their quality but, in the case of steel castings, would only inspect a few samples. The reason has been that the weld required only from one to five per cent of the total volume of the metal to be X-rayed, whereas examining a casting means radiographing practically the entire volume.

However, this can be done economically with the million-volt tube which, on flat areas, permits 64 times the volume of metal to be examined per man-hour. This is because the big tube can be placed far back from the job, and a large area sprayed with X rays at once. A large film in back of the casting will record the entire area in one shot. With lower power, the tube must be placed much closer to obtain the desired intensity.

It is amusing, said Mr. Moriarty, to watch the face of an uninitiated chipper when he is told where to chip on a casting, how far below the surface to go, and what he will find when he gets there. His look of patient resignation turns to something akin to awe, when he uncovers the predicted defect.

When the chipping is completed, the holes are filled by welding, and the casting is again X-rayed in the regions of major repair. After the casting is finally released the radiographs and other records are filed, to be kept for ten years.

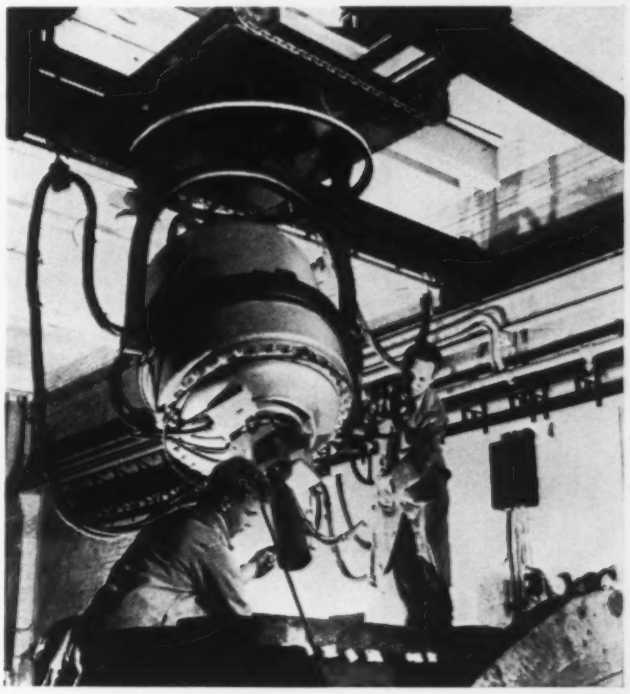


FIG. 3 POSITIONING 1000-KV X-RAY EQUIPMENT PREPARATORY TO RADIOGRAPHING A CASTING

Some conception of the sensitivity possible with X rays of 1000-kv peak is shown in Fig. 2 which is a reproduction of a radiograph taken through lead filters of a $4^1/_2$-in-thick weld. On the tube side of the weld, standard single-thickness-type A.S.M.E. penetrameters ranging in thickness from 2 per cent of $4^1/_2$ in. to two per cent of 2 in. were placed during the exposure. On the original the smallest hole in the 2-in. gage can be seen. This hole has a diameter of approximately $^5/_{64}$ in., which is equal to slightly less than 2 per cent of the plate thickness. The outline of the 2-in. gage, 0.020 in. thick, can be clearly seen on the film which indicates that defects of a thickness less than one per cent of a $4^1/_2$-in. plate can be detected.

Magnetic Oil Filter

MACHINERY LLOYD

THE most fruitful source of wear on bearings and other working surfaces is the presence of metallic particles in the lubricating oil or cutting fluid, according to an article published in the July 26, 1941, issue of *Machinery Lloyd* (Leicester, England). The particles giving the most trouble are those small fragments of iron or steel which contaminate the oil after being produced by wear from the sliding parts. Therefore the extraction of these ferrous particles is most important, and this should be done without interfering with the free circulation of the oil. Recently a simple and efficient method has been devised of achieving this separation by the use of Philips magnetic filters, of the type shown in Fig. 5. These filters comprise a cylindrically shaped permanent magnet having pole pieces at each end. Between the pole pieces are five two-sectioned iron rings interconnected by brass strips in such a way that an air gap is left between the rings. The magnetic flux from the magnet passes from the pole pieces across the rings and therefore traverses the six air gaps. A nonmagnetic sleeve fits over the magnet and the whole device is mounted in a nonmagnetic outer casing.

The liquid to be cleansed is allowed to flow between the inner wall of the housing and the outer and inner side of the rings, so that the field on both sides of the air gap is used. As the liquid passes these gaps the iron and steel particles in suspension will be drawn in between the gaps. Naturally, the first air gap fills first, and when full further particles pass to the second gap and so on, until all gaps are filled. At this point the filtering action ceases, the filter is saturated, and must be cleaned. As the iron rings are in halves the two parts may be easily removed from the magnet. As they are of soft iron, they then immediately lose their magnetism and can easily be cleaned by washing in kerosene, gasoline, or trichlorethylene. The lid of the filter is held on by means of a toggle clip so that loosening the screw immediately allows the cap to be removed and the magnet to be withdrawn.

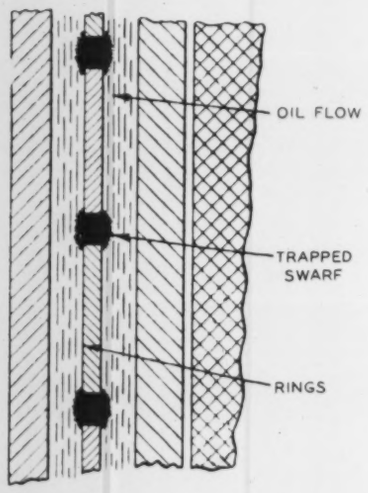


FIG. 4 ENLARGED PORTION OF FIG. 5 SHOWING HOW FERROUS PARTICLES IN THE OIL ARE ATTRACTED INTO THE AIR GAPS BETWEEN THE RINGS THUS LEAVING A FREE PASSAGE FOR THE OIL

A number of experiments have been conducted to establish the rate at which the filter extracts ferrous particles from the oil. These show that the speed of extraction depends on several factors, chief of which are the viscosity of the oil, the quantity of iron passing through the filter per hour, the size and nature of the iron particles, and the amount of iron already contained in the filter. The smaller the resistance encountered by the iron particles during their passage through the oil, i.e., the thinner the oil, the greater is the chance of these iron particles being drawn into the gaps. A high temperature is therefore conducive to a high speed of extraction.

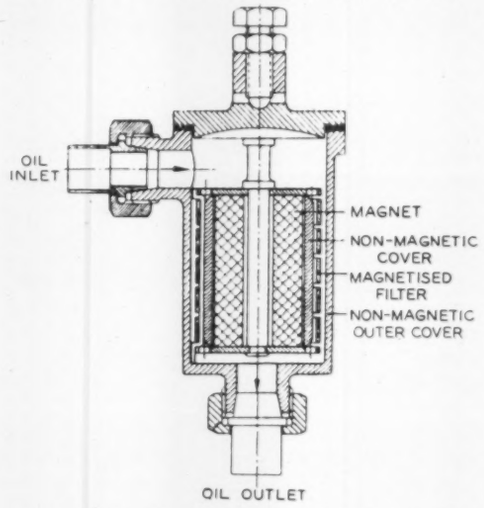


FIG. 5 SECTION OF PHILIPS MAGNETIC FILTER

(The contaminated oil passes across the air gaps formed by the rings surrounding the permanent magnet. The nonmagnetic cover over this magnet prevents the particles from adhering to the magnet itself.)

The amount of oil flowing through the filter per unit of time determines the speed at which the oil passes the gaps. The proportion of suspended iron that is drawn into the gaps depends upon this speed; the more the oil filter has to deal with per unit of time the smaller this proportion will be. Tests have shown that a good filtering action is obtained when 110 gal of oil flow through the filter per hour, and that in many cases the filtering action is more than sufficient at a flow of 130 gal per hr.

The magnetic filter, originally intended for the purification of lubricating oils, has also been found useful as a means of removing fine ferrous swarf from cutting oils. In this respect not only does the filter effect a considerable saving in the consumption of the cutting oil, but the extraction of the magnetic particles results in reduced wear of the working parts of the machine tool, while in the case of automatics greater tooling accuracy is obtained. Again in certain machine tools it is necessary to use an expensive cutting oil applied to the tool edge under high pressure through fine apertures, where the presence of swarf could cause damage in many ways. The success of the magnetic filter for cleaning cutting oils lies in the fact that its efficiency begins where other methods cease to function. The conventional weir and settling-tank methods are still essential for the initial removal of gross contamination, otherwise the trapping surfaces of the magnetic filter would be too quickly clogged. This would impair the efficiency of the filter for its real purpose, the removal of fine swarf which cannot be filtered by other methods.

Where possible the magnetic filter should be installed in the suction line, thus affording economy in wear and tear on the

pump bearings; but no hard and fast rule can be employed as it frequently happens that pumps are in a semisubmerged position.

Another extremely valuable application of the magnetic separator is its use on hydraulically operated machine tools. Usually with this class of machine, filters are built into the oil circulation in order to prevent unnecessary wear. It has, however, been found that the addition of a magnetic separator has effected considerable improvement; for example. a magnetic filter was placed in the pipe line of a hydraulically operated planing machine which had been in service for a short time. During the first week after fitting, 4000 mg of iron was extracted by the filter, while during the second week 1018 mg was extracted.

Storing Liquid Carbon Dioxide

INDUSTRIAL AND ENGINEERING CHEMISTRY

TRANSPORTATION and storage of bulk low-pressure liquid carbon dioxide are discussed and compared with conventional high-pressure methods of handling in a paper by C. A. Getz and Eric Geertz in the September, 1941, issue of *Industrial and Engineering Chemistry*, Industrial Edition.

Carbon dioxide has become an important industrial chemical. It is being used extensively in dislodging coal in mines, in carbonation of soft drinks, for refrigeration purposes, in various chemical manufacturing processes, and in fire-extinguishing systems. The bulk, low-pressure liquid method of handling carbon dioxide is playing an important role in expanding these uses.

Carbon dioxide has been transported and stored in the liquid state since 1823. Cylinders of 50 lb capacity have been the usual container. Because of the high vapor pressure of liquid carbon dioxide at temperatures encountered in the temperate zone, it is necessary to make these steel cylinders of heavy wall construction. The tare weight ranges from 90 to 135 lb per cylinder. Cylinders must be tested periodically at a pressure of 3000 psi. The pressure which develops in a normally filled cylinder at 68 F is 850 psi, at 77 F it is 1136 psi, and at 86 F it is 1436 psi.

Carbon dioxide is also handled in its solid (dry ice) form at approximately —110 F. Dry ice can be handled without pressure equipment, but because of its extremely low temperature, considerable loss results from excessive heat input. Furthermore, dry ice is not a convenient source of carbon-dioxide liquid or vapor as needed by industry. It is necessary to crush the solid carbon dioxide, place it in high-pressure cylinders, and allow it to liquefy in order to obtain commercially usable liquid or vapor.

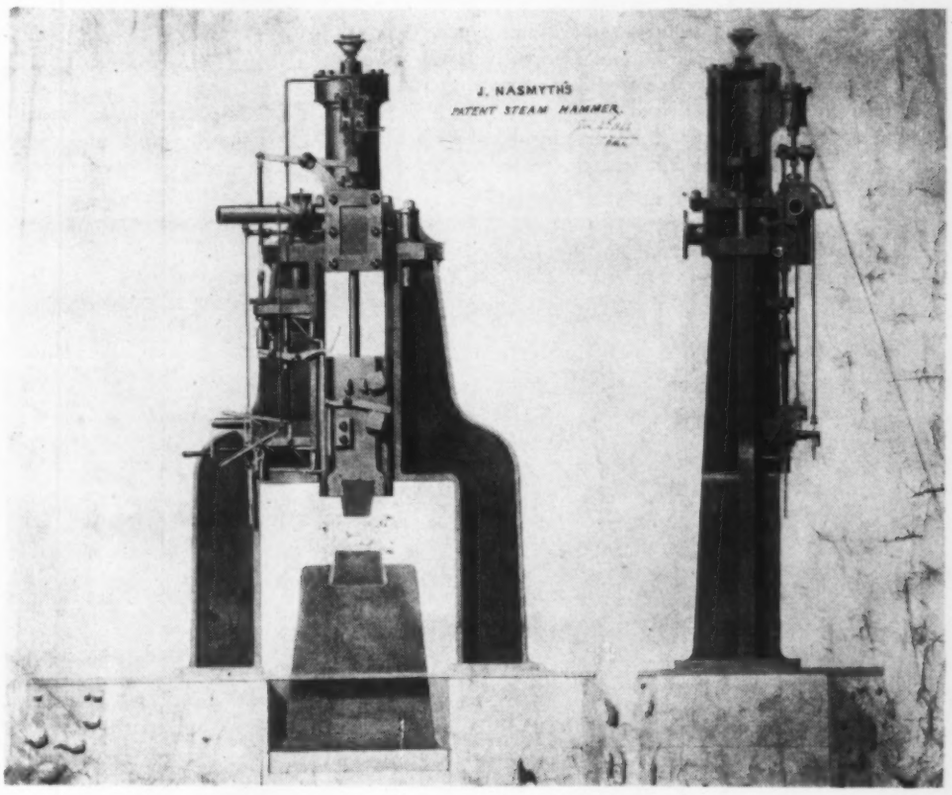
The handling of liquid carbon dioxide in the 50-lb-capacity cylinders is entirely satisfactory except for the excessive cost and inconvenience involved in handling the many heavy cylinders to obtain appreciable quantities of the gas.

The bulk low-pressure method of handling liquid carbon dioxide makes it possible to eliminate the majority of the objections to the high-pressure liquid method as well as to the dry-ice method. This new method takes advantage of the fact that a reduction in the temperature of liquid carbon dioxide results in a reduction in the vapor pressure. At a temperature of 0 F it is practical to use large pressure vessels instead of small steel cylinders. At this low temperature only 290 psi is exerted, so that relatively thin-walled pressure vessels can be used.

Each pressure vessel is thermally insulated to prevent rapid heat entrance from the surrounding atmosphere. The storage tanks are equipped with mechanical refrigerators to maintain a relatively constant temperature. Transport trucks and tank cars are not equipped with mechanical refrigerators because it is seldom that the pressure rises to the point where vapor must be relieved by the safety valves to maintain normal working pressure.

Storage tanks are built for a working pressure of 325 psi and are tested at 650 psi.

It has been found by experiment that the greatest refrigerat-



JAMES NASMYTH'S 1843 PATENT STEAM HAMMER—A TRACING IN INK OF THE ORIGINAL DRAWING RECENTLY PRESENTED BY THE INSTITUTION OF MECHANICAL ENGINEERS, LONDON, ENGLAND, TO CHAMBERSBURG ENGINEERING COMPANY

(For an interesting and informative article about the Nasmyth steam hammer and the controversy over it, see MECHANICAL ENGINEERING, June, 1929, pp. 445–447, "The Invention of the Steam Hammer," by H. W. Dickinson; and November, 1928, p. 869, letter by John L. Cox, "The First Steam Hammer"—Editor.)

ing effect is obtained when the cooling coil is placed in the vapor space at the top of the tank.

The refrigerator is started and stopped by a mercury switch operated by a Bourdon tube under tank pressure. Usually this switch is set to make contact at 305 psi and to break contact at 295 psi.

Various safety devices are supplied to relieve pressure in case the refrigerator fails to function properly. A special diaphragm-operated relief valve with a synthetic-rubber seat is provided which is set to relieve carbon-dioxide vapor at 345 psi. This valve functions to refrigerate the storage tank by bleeding vapor at a slow rate. It is bubble-tight below the upper limit of the normal operating range.

The diaphragm valve does not meet the A.S.M.E. Code requirements so it is necessary to provide direct spring-loaded pop valves. It was found that soft-seated valves of this construction did not operate precisely so it was necessary to use a metal-to-metal valve. This type of valve is not bubble-tight but by inverting it and flooding the seat with oil, a satisfactory leak-proof valve is obtained. Two such direct spring-loaded valves are provided on each low-pressure storage and transport vessel.

A dual control valve is provided to make it possible to service the relief valves. This is designed so that tank pressure can be shut off from the various relief valves. It is impossible to shut them all off at one time.

The direct spring-loaded relief valves are set to relieve at 357 psi which is 10 lb above the diaphragm-valve relieving pressure.

In addition to the pressure-relief valves the tank is provided with a frangible diaphragm assembly. The diaphragm bursts at a pressure of 600 psi. This is 50 lb below the pressure at which the vessel is tested when manufactured. A valve is placed in the line leading to the frangible diaphragm so that it is possible to change the diaphragm if corrosive atmospheres should be present. This valve is designed so that it can be locked only in the open position.

A number of 4-ton storage tanks were insulated with various media, and the insulation efficiencies studied at an outside temperature of 100 F and a liquid-carbon-dioxide temperature of 2 F.

TABLE 1 INSULATION EFFICIENCY DATA

Type of insulation	Insulation thickness, in.	CO_2 bled for constant pressure, lb per hr	Heat input to tank, Btu per hr	K factor	Pressure rise, lb per sq in. per hr	Refrigerator running time, per cent
Vegetable cork....	8	8.9	1060	0.420	1.24	32.3
Rock cork.....	8	10.5	1250	0.494	1.56	35.0
Kapok.....	8	14.0	1670	0.662	2.05	45.6
Vacuum, 30 in. Hg.	5	53.5	6360	1.58	..	..
Vacuum, 15 in. Hg.	5	71.2	8460	2.10	..	..
Dead air space....	5	80.8	9620	2.38	..	..

Table 1 gives the results of these tests. Column 2 shows the pounds per hour of CO_2 bled to maintain the pressure at 300 psi in the tank with the refrigerator not working.

Column 3 gives the corresponding heat input to the storage tank.

The K factor is the average heat transfer per square foot of tank surface per degree F temperature difference for one inch of insulation thickness. This value includes heat transfer through piping as well as insulating material.

Column 5 shows rate of temperature rise after the rate became nearly constant.

Column 6 shows the percentage of refrigerator running time for a 1-hp Freon refrigerator with an ambient temperature of 100 F.

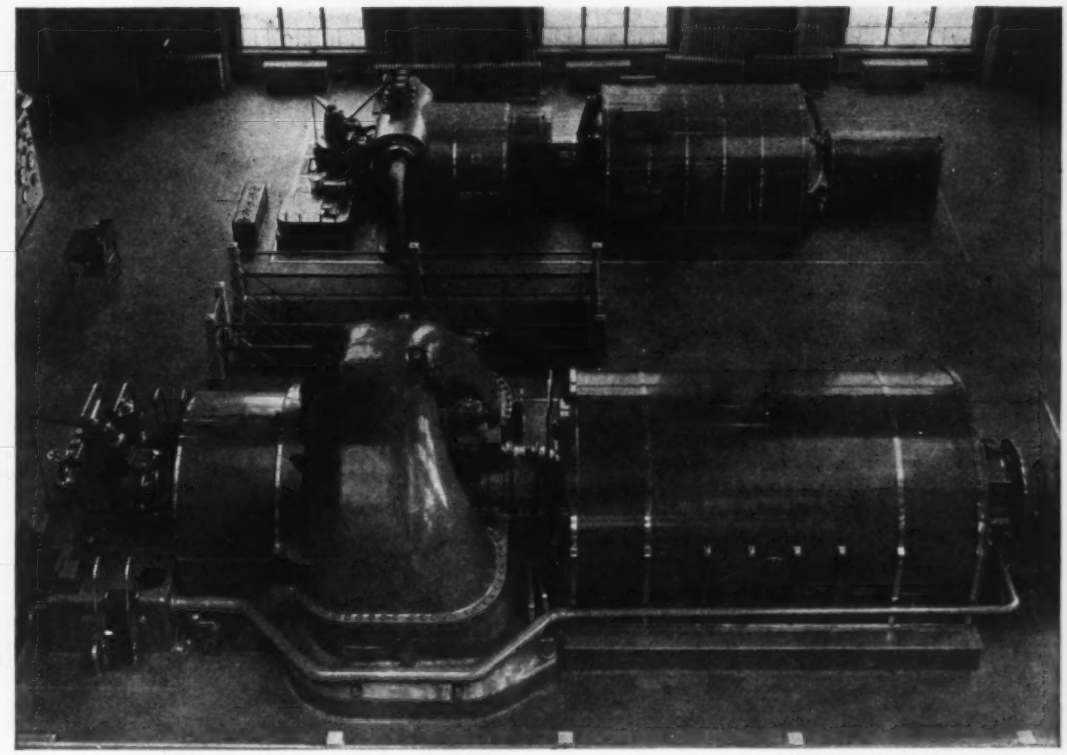
More Tanks M-3's, M-4's

THE American Locomotive Company will shortly let contracts for government-financed expansion of its Schenectady plant which will more than double present facilities for producing medium tanks. This company which produced the first M-3 tank and was the first to get it into regular production is now putting out more than two a day and arrangements are being made to increase this to three a day, the probable limit of present facilities.

Montreal Locomotive Works, a Canadian subsidiary of the company, has just completed a tank arsenal which will be second in size only to the Chrysler plant in Detroit. It is expected to turn out five tanks a day and is producing about two a day at the present time.

William C. Dickerman, chairman of American Locomotive Company, disclosed that work is proceeding on a pilot model of the M-4 medium tank. This improved model will mount its 75-mm gun in a 360-deg revolving turret and the hull will be fabricated partly of cast armor plate and will use more welded construction.

M-3 TANK LEAVING PRODUCTION LINE AT SCHENECTADY WORKS OF AMERICAN LOCOMOTIVE COMPANY



THE 76,500-KW, 2300-PSI, 900-F, CROSS-COMPOUND TURBOGENERATOR AT TWIN BRANCH

The Chrysler arsenal is currently producing about eight M-3's a day and the mark is fifteen by the end of the year, which will again be doubled. Others in the program for the big push next year are Baldwin Locomotive Company, General Motors Corporation, Lima Locomotive Company, Ford Motor Company, Pullman Standard Car Manufacturing Company, and Pressed Steel Car Company, Inc.

Twin Branch Hits 10,200 Btu

ELECTRICAL WORLD

PERFORMANCE surpassing that of any other installation in the United States is anticipated for the new 2500-lb-pressure Twin Branch steam-electric station of the Indiana & Michigan Electric Company near South Bend, Indiana.

The October 18, 1941, issue of *Electrical World* contains eight articles describing this station and its operation. The following excerpts are from two of these by Philip Sporn, vice-president and chief engineer, American Gas & Electric Service Corporation, member A.S.M.E.

Aim of the Twin Branch 2500-psi project from the very beginning was to make a definite and forward step in the economics of generation of central-station power. It was believed that the time had arrived when the technological limitations to higher pressure and high-temperature steam-electric generation could be advanced and thus contribute both to the capital cost and thermal economies of steam-generated power. This idea was reinforced through extensive discussions and negotiations with the group of forward-looking manufacturers of the principal items of equipment without whose proffered help and cooperation the project could not have been undertaken.

Twin Branch is the main generating station of Indiana & Michigan Electric Company, which is part of the Central System of American Gas & Electric Company. The whole Central System serves a combined industrial and residential load, with the industrial load predominating. Supply of power for Indiana & Michigan Electric Company's load is closely coordinated with that of the Central System, but requires a certain amount of generation locally.

Twin Branch, being the most expensive fuel point on the Central System, is the logical place for the thermally most efficient units on the system. Not only have fuel costs risen since the project was undertaken but the local load, initially estimated to reach a demand of some 165,000 kw by the time the 2500-psi unit went on the line, has actually reached a value of some 225,000 kw thus far in 1941, with a now expected peak in 1944 of some 290,000 kw. Thus, the developments in the intervening four years have not only justified the bases behind the original aims but have strengthened them.

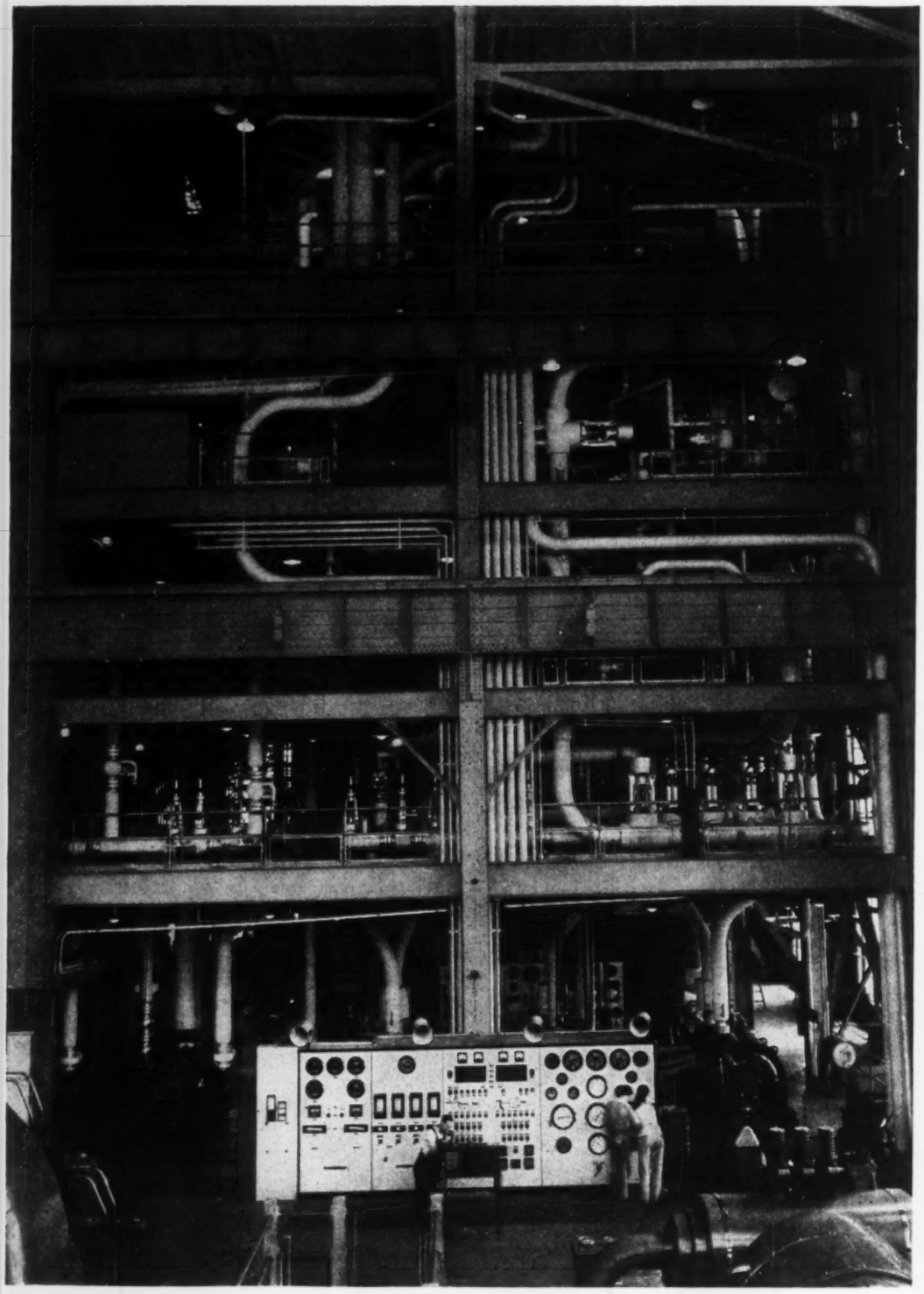
ORIGINAL PLAN

Technically, the project which was rated initially at 67,500 kw was outstanding for the decision to resort to a single natural-circulation boiler, a cross-compound generating unit, of which the high-pressure end would be rated at 22,500 kw at 3600 rpm with a hydrogen-cooled generator, and the low-pressure, a 40,000-kw unit, at 1800 rpm with an air-cooled generator, solid switching of high- and low-pressure turbines as a unit stepping up through a single transformer bank, turbine-driven high-pressure boiler feed pumps, and low-shell-pressure heaters throughout.

MODIFICATIONS OF ORIGINAL PLAN

Final development of a project having so little precedent resulted in modifications of some of the originally proposed ideas. But it is quite astounding how few these were—particularly of a fundamental nature.

First among such changes was the increase of the unit size



BOILER AUXILIARIES AND PIPING IN GALLERIES BETWEEN TURBINE ROOM AND THE 2500-PSI BOILER

from 67,500 kw to 76,500 kw. As the heat cycle was developed, it was found that not only could greater capacity be developed from the low-pressure machine than originally contemplated, but that the additional steam flow to the high-pressure turbine made possible better economies. The only obstacle to this was heating limitation on the originally contemplated air-cooled alternator for the low-pressure machine. Redesigning this for hydrogen cooling gave a larger machine, a better-balanced unit, and an improvement in the economics of the project. Another significant change was from turbine to motor drive for the boiler feed pumps. In respect to this change a thorough analysis indicated that, because of lower first cost and improved cycle efficiency, motor drive was more logical.

A third change was the use of high-pressure heaters for the 14th-stage high-pressure and the crossover extraction points made necessary by the changed position of the high-pressure boiler feed pump. The determining factors here were the fear

of difficulties with 490 F water in the pump and the additional pumping load this would have involved.

For the rest, the original projected ideas were adhered to. The boiler was not only built as a natural-circulation boiler, but it was done with mounting confidence in the soundness of the design from a circulation viewpoint. The design of the whole plant was kept on the simplest lines. This held true throughout the job. Above everything, there was no striving for thermal records, per se, indulged in nor was the job "babied," so to speak. In short, it was handled like any other commercial job in power-plant design, with the necessary emphasis on economy and on the economic features.

Twin Branch station's extension at 2500 psi was first placed in service late in March of this year. Except for several simple though time-consuming corrective steps it has been in continuous commercial operation at the design pressure. It is true that the primary superheated-steam temperature is not quite up to designed performance and this deficiency of some 80 deg in steam temperature is being reflected in a temporary way in the thermal performance.

THERMAL PERFORMANCE

Sufficient operating experience has not yet been obtained to permit a detailed discussion of thermal performance of this unit. However, to give the drift of performance, the ensuing tabulation is given covering two periods of operation as reported by the operating department. There is further every indication of substantial improvement.

	Accumulative 622.83 hours, May 12 to June 6, 1941	Accumulative 168 hours, June 24 to June 30, 1941
Kwhr generated	32,236,000	11,092,000
Avg kw generated per hour	51,757	66,024
Kwhr auxiliary	2,143,000	706,100
Output	30,093,000	10,385,900
Coal used, lb	29,886,000	9,722,000
Oil used, gal	2,570	0
Heat value of coal	10,354	10,886
Lb coal per kwhr generated	0.927	0.876
Lb coal per kwhr output	0.993	0.936
Btu per kwhr output	10,282	10,189
Thermal efficiency	33.18	33.49

Although some work remains to be done on this project to reach the goal set for it, it is gratifying to all concerned that after more than six months' commercial operation the unit is giving a good account of itself. Considering the number of difficult problems that confronted the equipment and project designers and the uncharted area they had to traverse, one can perhaps without exaggeration call this a bold achievement.

The high-pressure turbine bearing vibration difficulty appears to be completely corrected. The carryover problem, while not entirely solved, is definitely within practical and easy control. Steam temperature or heating surface distribution and slag control are still awaiting complete solution, yet clearly appear to be on the road to such a state. With these exceptions, all other difficulties have been of a minor nature.

Circulation, piping, pumping, valving, and other difficulties failed to materialize. Difficulties with regard to steam generation or high-pressure turbine plugging predicted by those who had carelessly taken large doses of steam-solution theory also failed to materialize or have been put under operating control. The designers of the project and of the equipment concerned have every reason to believe that with their completion of boiler modifications the availability and performance of the unit will surpass design expectations. It has been definitely proved that 2500-psi natural-circulation boilers and 2300-psi steam turbines are technically sound and commercially workable.

New Process for Liquefying Air

NATURE

IN NEARLY all refrigeration processes, whether for the moderate cooling associated with food preservation or for the liquefaction of the "permanent" gases, the operations are basically similar, according to J. H. Awbery in the July 5, 1941, issue of *Nature*. A gas or vapor is compressed, the heat due to this compression is removed, and the fluid then allowed to expand, whereby it cools below the temperature of its surroundings. In the Linde process for making liquid air, the compression is to about 200 atm, and the expansion takes place through a nozzle, the resulting cooling being that due to the Joule-Thomson effect; the process is made cumulative by using the cold air to lower the temperature of the air which is still approaching the nozzle. Now the Joule-Thomson effect is by no means large in gases so nearly perfect as air, and it has long been realized that much greater cooling could be obtained in the expansion if this could be carried out in such a way that the gas did work, so that more energy would be removed from it. Mechanical difficulties, such as that of lubrication and of avoiding excessive heating due to friction, have caused designers to favor the theoretically less efficient expansion valve, though Claude had successfully applied the principle as early as 1906.

In an article in *Voks Bulletin* (November-December, 1940), Prof. P. Kapitza gives a brief description of an installation which has now been set up at the Institute of Physical Problems of the Academy of Sciences of the U.S.S.R., in which the expanding air does work by driving a turbine. The increased temperature fall, as compared with free expansion through a nozzle, is so great that the initial compression need only be of the order of 5 atm instead of the 200 atm necessary in Linde's process.

The main difficulty to be overcome was the design of the turbine itself, which is quite inefficient if the axial-flow impulse turbine used with steam is taken as a model. Owing to the low temperature, the air flowing through the turbine has a density five times that of steam at 250 C, so that there is a considerable centrifugal force as the fluid whirls around, and this must be taken into account, just as it is in a water turbine.

The present apparatus, which will be followed by larger ones, has a piston compressor working at 400 rpm, taking 50–80 kw of electrical energy and delivering nearly 600 kg of air per hour at about 7 atm. The compressed air then passes a water cooler and through the regenerator (cooled by previously treated air) to the turbine. The latter works at 40,000 rpm and yields 4 kwhr of mechanical energy. The pressure drop is 4 to 1, and the cooling is such that air entering at —158 C emerges at —187 C (the boiling point of oxygen), implying the extraction of 3700 calories per hour. The efficiency is thus 0.79–0.83. The regenerators also offer some novel features. There are two of them, used intermittently for about 26 sec each, the changeover being effected automatically. They are filled with flat ribbon, 0.1 mm thick and 50 mm wide, with nodules.

From the turbine, the main air stream is passed through the inner tubes of a condenser, only a small by-passed stream flowing through the outer tubes and being liquefied therein. The over-all efficiency of the apparatus is such that it gives 29–30 kg of liquid air per hour, at an energy cost of 1.7 kwhr per kg. It is calculated that this can be reduced to 1.2 kwhr per kg by making use of the mechanical energy from the turbine and by more suitable valves and other equipment, so as to utilize the full seven atmospheres compression, instead of only four sevenths of it. If so, the apparatus will have about the same efficiency as present high-pressure installations.

COMMENTS ON PAPERS

Including Letters From Readers on Miscellaneous Subjects

Aims and Objects of The American Society of Mechanical Engineers

To the Editor:

The disappointing aspect of W. F. Durand's discussion of "Aims and Objects of The American Society of Mechanical Engineers"[1] is his failure to emphasize the part that engineers should play in the reorganization of the world that is tumbling about our ears. He still has the narrow view of professional service, a view that accounts for the narrow influence of engineers in the settlement of our social and economic problems. He is concerned more with the mechanics of the Society's operations than he is with the basic principles of scientific inquiry as it affects engineering service to society. With The American Society of Mechanical Engineers, as with a man, it is not what a man wears or the tools he uses that show his character but rather his philosophy of life. But Dr. Durand has no philosophy of life for the Society.

A book that left its impress was published some years ago by a famous educator, Andrew D. White, entitled, "History of the Warfare of Science With Theology in Christendom." The day is coming when somebody, perhaps a century from now, will write a similar book on the warfare of science with capitalism. The attitude of the church in resisting scientific progress is difficult today to understand. The attitude of capitalism in resisting today the progress of applied science will be equally incomprehensible, perhaps a century from now. Engineers who are largely in the employ of corporations are to capitalism what the priests of the Middle Ages were to the church. Engineers, therefore, should recognize the part they might play in solving the problem of the warfare of science with capitalism.

The applied science of engineers has made possible the overproduction of goods to the point that capitalism and labor seek to protect profits and wages by restriction of production. Compare Thurman Arnold in "The Bottlenecks of Business." The glut of oil, rubber, cotton, tea, coffee, wheat, tin, copper, sugar, and silk has plagued the world to the point that agreements have been made to limit production. Compare the National Industrial Conference Board in "International Raw Commodity Control." On manufactured products, the control of prices and profits has taken the form of agreements between corporations in various countries whereby the world markets have been divided. Compare recent hearings of the Temporary National Economic Committee, Seventy-Sixth Congress. Other restrictive methods used include high tariffs, preferential tariffs, exchange restrictions, undue control of labor-union membership, and various barriers to the free exchange of goods too numerous to mention.

In contrast with limited production and protection of profits or wages, we have seen the recent spectacle of millions of men out of work, starving, without adequate shelter or clothing, and unable to pay for the goods they needed so badly. Temporarily the war has put those men to work but the problem of food, housing, and clothing for them will hit society anew with greater force as soon as peace is declared. Yet The American Society of Mechanical Engineers is doing little about the problem, so little that a former president of the Society in a discussion of its aims hardly touches upon it.

The average engineer in replying to the preceding criticism will point to the publication of technical articles and the support of research by the Society. He will recall the address by W. L. Batt, entitled, "Through a Glass, Darkly,"[2] and the address by Robert E. Doherty, entitled, "Social Responsibility of the Engineer."[3] Such an answer, however, has as little to do with the basic issue as the service of the good Samaritan who bound up the wounded man but left the thieves unmolested. Like the Levite, the Society is interested in serving its own members and the advancement of their professional standing. Like the Samaritan, the Society is concerned over service to young engineers. But any discussion before the Society of the problem of controlling the thieves appears to be almost taboo.

These strictures to have weight must be supported by a bill of particulars. Space available forces limitation of it to one incident and to two papers that are available to Society members.

At the sugar session of the Society, at the Annual Meeting in New York a few years ago, comments were made on various methods of refining sugar. One listener queried as to their capital and operating costs. The chairman quickly ruled the query out of order on the ground that the meeting was concerned only with technical problems and not with their economic aspects. In the name of common sense, however, how are engineers to arrive at sane decisions on technical problems if they cannot have data as to the economics involved? The chairman, as an employee of a sugar-refining company, may not have cared to have any data brought out that could be used to suggest considerable obsolescence existed in the industry. Yet only as engineers show the existence of obsolescence can they get the lower costs and increased sales that are a part of their oath to serve their fellow men.

The first paper to which reference is made was published in Mechanical Engineering, April, 1941. It is entitled, "Inland Ocean," and is by L. K. Sillcox of the New York Air Brake Company. He argues that canalization of the St. Lawrence River is not justified. He may be correct, and undoubtedly he is honest in his opinion. A substantial body of opinion, however, does not agree with him. At least two books by engineers have shown an opposite conclusion. The article as published had a limited bibliography although an extensive literature exists.

The publication of Sillcox's article by the Society is in line with the thesis of this discussion that the Society should take a more active part in discussions of economic engineering questions. The mistake made was the publication without opportunity for rebuttal as though it

[1] "Aims and Objects of The American Society of Mechanical Engineers," by W. F. Durand, Mechanical Engineering, September, 1941, pages 667–670.

[2] Mechanical Engineering, January, 1941, pages 5–8.

[3] Mechanical Engineering, September, 1939, pages 653–656.

were the last word on the proposed St. Lawrence waterway. Mr. Sillcox, as an employee of the New York Air Brake Company, a concern interested in the welfare of the railroads, has a right to be heard, but the general public and his opponents should also be heard.

The second paper was a case study of electrical rates and service in a suburban community. It was submitted in May, 1937. The argument was made that rates for electricity for heating water and cooking could be made so low that the sale of manufactured gas for such service would become economically unattractive. The effect of low rates for electricity on better street lighting as a deterrent to accidents at night from automobiles was also discussed. The paper was supported by about 150 bibliographical references.

The conclusion was reached that, for a suburban community with about 13,000 in population, annual savings of about $200,000 and a capital expenditure of about $1,000,000 for electric equipment were involved. These results were shown to be related to the problem of work for men and a higher standard of living. Lack of socially minded management by the large public utility concerned was the obvious inference.

The case study had broader implications than the preceding, for the conclusions as to competition between low-cost electricity and manufactured gas apply generally throughout the East where both are sold frequently by the same public utility or interlocking financial interests. Obsolescence of an investment of about one billion dollars in the manufactured-gas industry is involved.

The Society took, however, about two and one-half years to get to the point where the paper could be presented. Except for the support of the Management Division, the paper probably never would have been presented. The fact that the author had to meet several arguments in obtaining consent to the presentation is symptomatic of the reasons for the failure of The American Society of Mechanical Engineers to serve society as it should.

The first argument was that the first draft of the paper was too long although the secretary of the Society had a letter offering to condense it to such length as was mutually agreeable. The second argument was that only accounting was involved; but every engineering discussion should be basically a study in economic accounting. The third and last argument was that the paper was in poor English, although that criterion as a means of selecting papers would bar many an important technical contribution.

In agreement with two of the Society's committees as to the length acceptable for publication, the paper as presented had been condensed to about 15,000 words. At the last moment, however, the author was asked to pay for mimeograph copies. He was told later that publication was not possible because of a length that had been previously accepted. Then the author suggested that the body of the paper, a few thousand words in length, could be published by omitting appendixes and bibliography. The latter could be sent in mimeograph form to those members of the Society that might request them. Nine months, therefore, after the presentation of the paper, committees of the Society are still struggling with the problem of whether the paper should be published.

The contrast in the treatment given the two papers by The American Society of Mechanical Engineers is a good indication that a philosophy of life is needed to guide it. He who criticizes the policies of the U. S. Government appears to have no difficulty in being heard but he who dares to criticize a large public utility and important financial interests will have the greatest difficulty in being heard. Yet if the Society is to serve men, its platform must be open to all engineers regardless of the conclusions they have reached.

A good comment on the preceding is an article by Prof. Eliot Blackwelder entitled "Science and Human Prospects" that was abstracted in MECHANICAL ENGINEERING for June, 1941. He wrote as follows:

> We have used the scientific method in engineering and medicine for a century and have found it good—far more effective than the old ways of speculation or of trial and error. In spite of the difficulties involved why not then extend it to other fields?
>
> To have science flourish, there must be complete freedom of inquiry and discussion. The beneficial influence of such freedom is indicated by the extraordinary development of philosophy and the sciences among the Greeks in the fourth to sixth centuries B.C., in the Germany of the nineteenth century, and in modern America. Scholars properly insist on this necessity and guard their hard-earned right to intellectual liberty; nor is this freedom of research so firmly held but that it takes a little defending, all the while, from the bigots who would close to discussion certain trends of thought of which they chance to disapprove.

In the words of Professor Blackwelder, why not extend the method of scientific discussion to the economic engineering involved in the operations of large corporations? Why not apply to capitalism the same technique that has been applied to pure engineering? Therein lies the opportunity of The American Society of Mechanical Engineers to serve society. By such discussion, in the give and take of open debate, engineers will be able to point the way to lower costs, increased sales, and higher standards of living for those fifty million people who are living under subnormal conditions.

The papers presented before the Society, however, are too often of the pick-and-spade variety. They are those of the hired workman and not the planner. The type of papers that should come before the Society, in addition to the narrowly technical papers that are now so common, might include the following:

A discussion of the recent report by Gano Dunn on the necessity for expanding the steel industry. Or an attempt to indicate what might be done to help the railroad industry. In all these papers, the emphasis should be on the capital and operating costs involved in any proposed solution. Such an approach is peculiarly the province of The American Society of Mechanical Engineers as opposed to the generalities that are characteristic of the papers before the American Academy of Political and Social Science. Somehow the Society has got to find a way of getting published so-called confidential data as to costs. Only thus can engineers show the way to lower production costs, increased sales, and the higher standard of living that will come with recognition of existing obsolescence. For obsolescence is the issue on which there is constant warfare between applied science and capitalism.

No better conclusion to this discussion is possible than to quote from the words of Vannevar Bush, president of the Carnegie Institution of Washington, before the American Engineering Council, on "The Professional Spirit in Engineering."[4]

> If there is no central organization which has as its creed the best service of the profession to the society of which it forms a part, then there will be in the end no engineering profession. Professional status rests in perpetuity . . . upon the respect and fundamental support of the people who are served; . . .
>
> Will engineers support such a program? . . . Will they make possible great forums for the crystallization of engineering opinion on public questions involving engineering, not to attain an impossible unanimity of high-sounding resolutions, but so that all aspects of controversial matters may be aired in order that people may know what engineers think? . . . Will they accept as the central theme the engineers' ministration to society, without fear of class, and without prejudice toward or away from any special interests or causes?

Mr. Bush concludes that if engineers will not do these things,

> We may as well resign ourselves to a general absorption as controlled employees, and to the

[4] MECHANICAL ENGINEERING, March, 1939, pages 195–198.

disappearance of our independence. We may as well conclude that we are merely one more group of the population, trained with a special skill . . . with no higher ideals than to serve as directed, and with no greater satisfaction than the securing of an adequate income. . . .

GREGORY M. DEXTER.[5]

TO THE EDITOR:

Dr. Durand in his presentation of the "Aims and Objects of The American Society of Mechanical Engineers" in MECHANICAL ENGINEERING for September, 1941, presents for consideration "two major aspects,

"1 Service to the individual engineer.

"2 Service to the profession, in which may be included service to the public and to the world at large."

It is noteworthy that a project undertaken a decade ago as a service to the individual has developed also into a major contribution to the objectives in Dr. Durand's second major service. I refer to the fine response of some older members of the Society to the protest of an indignant youth that the Society was not aiding the economic status of its younger members. The Society proposed to do something about it; and it did; out of it came Engineers' Council for Professional Development, the outstanding joint activity in Engineering, directed to the development of young engineers as a means of enhancing the professional status of the engineer and his "effectiveness in dealing with technical, social, and economic problems."

At one of the E.C.P.D. participation sessions of the A.S.M.E. convention at Kansas City in June, I recounted the interrelation of A.S.M.E. and E.C.P.D. which I briefed thus:

When the A.S.M.E. awoke to the economic status of its protesting juniors it proceeded to explore the economic and professional status of its members; it found a problem for the Profession. A conference of engineering groups produced a "Plan of Action;" E.C.P.D. emerged "to enhance the professional status of the engineer through the cooperative support" of national societies. The spirit and vigor of the A.S.M.E. which aided in the formation and development of E.C.P.D. it is our privilege to perpetuate.

That seems to sum it up; I am sure that the early reports and addresses of Lauer and Hirshfeld, committee chairmen and pioneers, will bring to others the admiration and inspiration that they have given me.

CHAS. F. SCOTT.[6]

[5] Scarsdale, N. Y. Mem. A.S.M.E.
[6] New York, N. Y. Mem. A.S.M.E.

The Compression of Wood

COMMENT BY E. G. STERN[7]

This interesting paper[8] by R. M. Seborg and A. J. Stamm is the first presentation in the United States covering the elastic characteristics of compressed wood. The authors confined themselves to data on hickory only, compressed perpendicular to the grain. Hence, supplementary data[9] may be of interest.

The relation of the applied pressure perpendicular to the grain to the fraction of the original thickness of poplar of 10 to 15 per cent moisture content is indicated in Fig. 1 of this discussion, according to data by Messrs. K. Egner and O. Graf.[10] The increase in pressure below the fraction of 0.4 is evident. At 0.2, a pressure increase beyond the one shown is of no effect because of the evident disappearance of the tracheary elements,[11] and because of the specific weight of the wood which approaches that of both cellulose and lignin (1.56).

The moisture content of the wood does not greatly influence the correlation mentioned of the applied pressure and ratio of increase in density. However, only a small amount of moisture content may be disadvantageous because of the possibility of splintering during the pressing procedure.

As indicated in the paper, the moisture content of wood influences the increase in volume of the compressed wood after the release of the applied pressure. Data for compressed poplar are given in Fig. 2 of this discussion. During the first hour after release of pressure, the increase in volume, hence, the decrease in density, is approximately uniform because of the initial release of internal stresses. This observation does not depend upon the original moisture content of the material. During long periods, shrinkage and swelling of compressed wood gain in importance. The density of compressed poplar decreases, if material of a moisture content below 16 per cent is used, and increases whenever the moisture content is greater than 16 per cent.

[7] Research Engineer, Engineering Experiment Station, Virginia Polytechnic Institute, Blacksburg, Va.
[8] "The Compression of Wood," by R. M. Seborg and A. J. Stamm, MECHANICAL ENGINEERING, March, 1941, pp. 211–213.
[9] "Report on Compressed Wood," by E. G. Stern to the Engineering and Research Corporation, Riverdale, Md., 1940.
[10] "Report on Tests on Compressed Wood," by K. Egner and O. Graf, Materials Testing Laboratory, Stuttgart, Germany, 1936.
[11] See Fig. 2 of closure of paper, "Superpressed Plywood," by R. K. Bernhard, T. D. Perry, and E. G. Stern, MECHANICAL ENGINEERING, vol. 62, 1940, pp. 748–751.

During two pressing procedures, i.e. (1) radial, (2) tangential and perpendicular to the grain, poplar was compressed to approximately one half its original cross section at a pressure of about 4500 psi. A moisture content of 10 per cent was selected for the test specimens to obtain a similar moisture content for the manufactured material as when in use. The length of the compressed wood was about the same as that

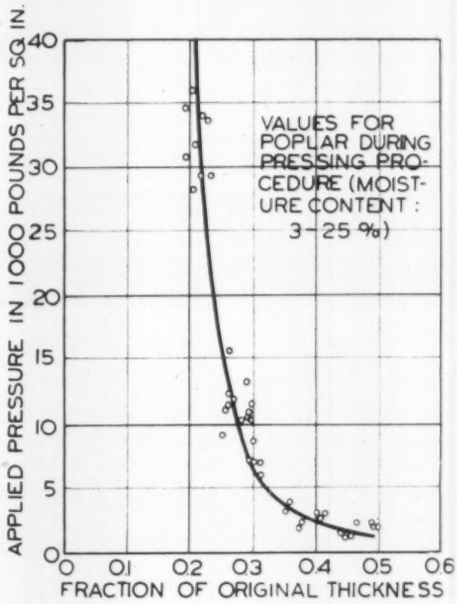


FIG. 1 APPLIED PRESSURE FOR WOOD, COMPRESSED IN ONE DIRECTION, AS RELATED TO RATIO OF INCREASE IN DENSITY[10]

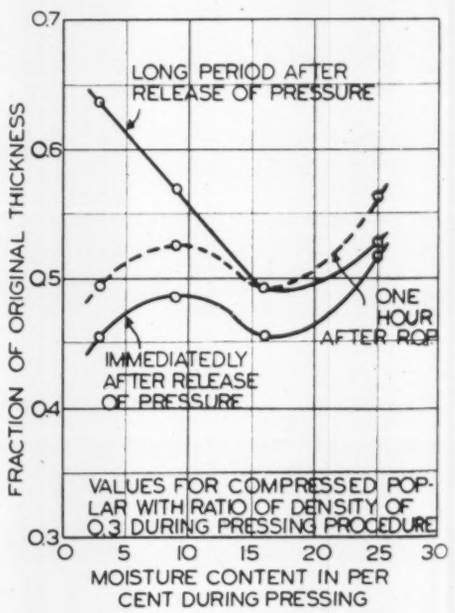


FIG. 2 DECREASE IN DENSITY OF COMPRESSED WOOD, AS RELATED TO MOISTURE CONTENT, DURING PRESSING PROCEDURE[10]

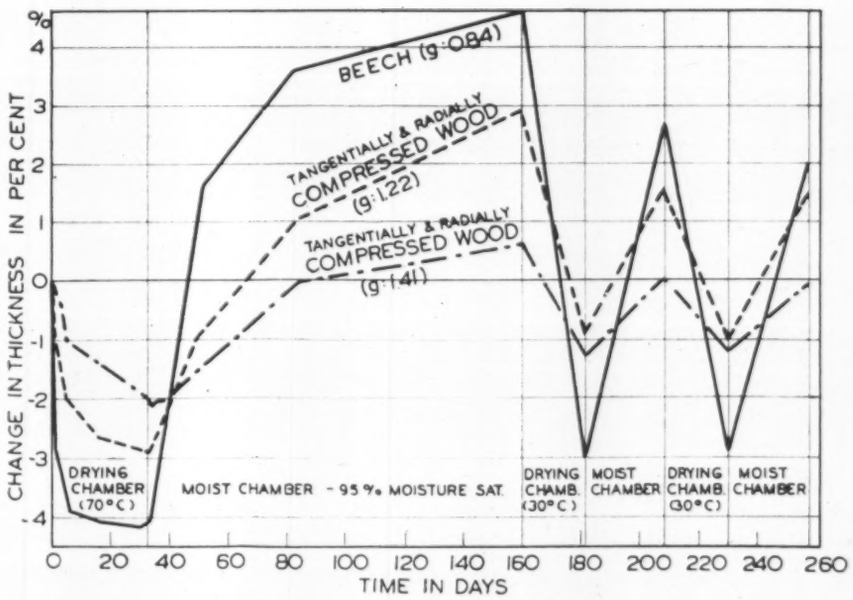


FIG. 3 CHANGE IN THICKNESS OF WOOD AND COMPRESSED WOOD IN DRY AND MOIST AIR[10]

of the original material. Consequently, the original volume was reduced about one half, and the specific gravity increased about 100 per cent. Not all of the compressed poplar showed the same specific gravity, depending upon the natural change in the specific gravity of the wood. The use of softwoods may be disadvantageous because of the different nature of their springwood and summerwood, which prevent an interlocking of the annual growth sections. Hence, birch, elm, and beech have been mostly used for the manufacture of compressed wood in Germany.

The influence of moisture content of the surrounding atmosphere on beech, compressed tangentially and radially, is smaller than on the untreated wood, as indicated in Fig. 3.

Before compressed wood is introduced for structural purposes on a large scale, it is recommended that data on its strength characteristics be obtained because of the fact that the existing information on the properties of compressed wood is rather limited and fragmentary. The available data, however, make compressed wood a promising construction material.

AUTHORS' COMMENT

The data of Egner and Graf[10] presented by Stern are interesting, but are subject to a different analysis from that discussed.

The change in thickness, given in Fig. 1 of his comment, does not represent true compression of the wood as some lateral flow must have occurred at the higher pressures. If the poplar used was yellow poplar, the dry-weight dry-volume specific gravity would be about 0.42. Dividing this by the true specific gravity of wood substance 1.46, determined in a penetrating nonswelling gas,[12] gives the limiting fractional compressed volume of 0.29. If the poplar was aspen or cottonwood, which are true poplars, the dry-weight dry-volume specific gravity might have been as low as 0.35. This gives a limiting fractional compressed volume of 0.24. These values are appreciably greater than the limiting-thickness change, given in Fig. 1, which is not surprising, as a certain amount of lateral flow is to be expected at the extremely high pressures used.

The specific-gravity value of 1.56 used by Stern was determined by water displacement and is applicable only for calculations of wood above the fiber-saturation point[13] and even in this case a better value to use is 1.53.[13]

Stern states that the moisture content of the wood does not affect the compression-applied-pressure relationship greatly. Actually, it has two very definite effects upon the relationship. In the low applied-pressure range, the fact that the plasticity of wood is increased by the presence of moisture will cause moist wood to compress more readily than dry wood. When the applied pressure appreciably exceeds the compressive strength of the dry wood perpendicular to the grain, which is the case for all the data shown in Fig. 1, this effect becomes less important.

When the applied pressure approaches that required to compress the wood completely, the space occupied by the bound water will reduce the extent to which the wood can be compressed. In the case of the wood at the fiber-saturation point (30 per cent moisture on the basis of the dry weight of the wood), the limiting fractional compressed volumes would be 0.36 and 0.30 instead of 0.29 and 0.24 for dry wood with specific gravities of 0.42 and 0.35, respectively.[7] The maximum compression can thus be reduced by as much as 25 per cent by the presence of bound water. Although some bound water could be squeezed out of wood at the fiber-saturation point under extremely high pressures, the amount is small. This decrease in compressibility with increasing moisture content is shown in Fig. 2 of Stern's comments. The S shape of the curves has no theoretical significance, as a linear relationship would be expected. Deviations from a sloping straight line through the data points are, undoubtedly, because of physical differences in the different wood specimens.

Stern gives 16 per cent moisture content as the critical moisture content, above which the compressed wood, shown in Fig. 2, shrinks and below which it swells after standing for long periods of time. This point is not a fixed point, but will depend upon the prevailing relative humidity. It is of interest that the dimension change per unit moisture-content change below the critical moisture content is greater than that occurring above the critical moisture content. This is due to the fact that the dimension change below the critical moisture content is due to relief of compression as well as swelling.

It should further be pointed out that the data plotted in Fig. 3 of Stern's comment do not represent equilibrium conditions. Under equilibrium conditions, the more complete the compression of the wood, the greater will be the swelling, regardless of partial relief of compression.

From a stability standpoint, the use of large compressed specimens may have some advantage over the uncompressed material when the relative-humidity cycles are comparatively short. When the relative humidity is either high or low for comparatively long periods of time, such as exist indoors between summer and winter in northern climates, the compressed wood will swell and shrink more than the uncompressed material. This should be kept in mind when using compressed wood other than that which

[12] "The Bonding Force of Cellulosic Materials for Water Incurred From Specific-Volume and Thermal Data," by A. J. Stamm and L. A. Hansen, *Journal of Physical Chemistry*, vol. 41, 1937, pp. 1007–1016.

[13] "Calculations of the Void Volume in Wood," by A. J. Stamm, *Industrial and Engineering Chemistry*, vol. 30, 1938, pp. 1280–1281.

has had a true stabilizing treatment.[14]

We agree with Stern that considerable strength data should be accumulated on compressed wood before its general use is recommended. This also applies to swelling and shrinking of different-sized specimens under varying relative-humidity cycles in which the relative humidity is held at both the high and the low points for periods varying from 1 week to about 6 months.

A. J. STAMM.[15]
R. M. SEBORG.[15]

[14] "Resin-Treated, Laminated, Compressed Wood," by A. J. Stamm and R. M. Seborg, presented at the Chicago Meeting of the American Institute of Chemical Engineers, May 20, 1941; to be published shortly.

[15] Forest Products Laboratory, Forest Service, U. S. Department of Agriculture, Madison, Wis.

Power-Operated Rakes for Hydraulic Intakes

COMMENT BY K. C. ROBERTS[16]

The paper[17] in review presents, in comprehensive form, the problem of trash removal from the intake works of hydraulic structures and the development of a type of mechanically operated rake for this purpose.

There appears to be no uniform approach to this problem, possibly because of wide dissimilarity in conditions between sites. The type and quantity of trash will vary according to particular characteristics of the watershed. The amount of trash in any given watershed, transported through the reservoir and likely to create a troublesome condition, will depend largely upon local conditions, such as, the type of vegetation and the occurrences of flood flows during seasons when large quantities of debris are in a position to be carried away. The necessary provision for the control of trash will also vary with the type and size of the intake structure. In this connection, it may be noted that the present trend of hydroelectric-plant design toward larger turbines, which permit the passage of debris of considerable size without injury, has led to the use of trash racks with large openings which readily pass the most frequently troublesome elements of trash, such as leaves and twigs.

The Tennessee Valley Authority has installed, in many of its later main river plants, trash racks with bars spaced approximately 10 in. on centers, which, up to the present time, have operated satisfactorily without raking, although adequate provision for the use of raking equipment has been made in the design. Whenever conditions arise, however, which definitely require that the racks be cleaned of debris, and where conditions permit its use, the power-operated mechanical rake is undoubtedly the most satisfactory equipment for the purpose.

At the Wheeler Plant of the Tennessee Valley Authority, the intake is equipped with trash racks with bars spaced approximately 6 in. on centers. It was found, during early operation of the plant, that trash accumulated during certain seasons in quantities sufficient to require an efficient means for its removal. A trash rake of the type described in the paper was installed, and has handled large amounts of debris satisfactorily.

That portion of the paper dealing with the construction and design of the rake hoist, and particularly with the choice of motor capacity, merits further emphasis. It does not necessarily follow that the larger the motor the better the design for any particular application. The ordinary electric-hoist motor is capable of exerting a torque considerably in excess of its normal full-speed running torque for short periods of time without injurious heating; and, under breakdown conditions, will exert a torque approaching 300 per cent of its normal full-speed running torque. In the event that the rake is jammed in the guides, or strikes an obstruction sufficient to prevent its travel while hoisting, an overload corresponding to this motor-breakdown torque will be imposed on the hoist mechanism. If the motor is chosen on the basis of a severe normal loading condition, the loads imposed under this breakdown condition will be correspondingly increased. If the hoist is designed safely to withstand the stresses imposed by this breakdown load, as should be the case in order to prevent possible serious damage and troublesome repairs, this condition will govern the design and will require a hoist of heavier construction than is required for ordinary normal operating conditions.

Consequently, we believe that a more economical and a more reliable design will be obtained if the motor is chosen and the hoist designed for a moderate loading assumption for ordinary operating conditions, with due provision for the stresses produced by the breakdown load, which does not assume serious proportions when the size of the motor is based on a moderate loading assumption. It may be considered that occasional loads in excess of design assumptions will be provided for by the ordinary overload capacity of the motor and hoist, without causing any serious injury or serious overstressing of any of the component parts.

[16] Senior Structural Engineer, Tennessee Valley Authority, Knoxville, Tenn. Mem. A.S.M.E.

[17] "Power-Operated Rakes for Hydraulic Intakes," by G. T. Abernathy, MECHANICAL ENGINEERING, April, 1941, pp. 269–272.

COMMENT BY R. V. TERRY[18]

For about 18 years the writer has been associated with the design of the so-called Newport News rack rake which is a development of the Jones, Sloan, and Randlett rakes, mentioned by the author, and of a special hoist arrangement designed by Benson.[19] About 115 rakes of that type have been installed in 30 states and in several foreign countries.

It should be pointed out that a rack-cleaning machine frequently has a rather rough job to perform, as anyone familiar with trash conditions at many hydraulic intakes will readily agree. Consequently, it is not infrequent that jamming occurs, resulting in some damage to the rake equipment. As mentioned by the author, rakes are usually proportioned so that, if they strike an obstruction near the points of the teeth, they will trip and ride over the obstruction. There are, however, many other ways in which the free movement of the rake may become obstructed by trash.

As mentioned by the author, separate log hooks, of the type shown in Fig. 6 of the paper, are sometimes provided. These have not proved entirely successful and improvements in this respect are needed.

For the satisfactory operation of mechanical-rack rakes, it is important that fixed guides be used and that the guides be accurately set.

AUTHOR'S CLOSURE

The author wishes to thank those contributing discussions to this paper.

As pointed out by Mr. Roberts, there appears to be no uniformity of approach to the problem of trash removal because of variations in type and quantity of trash. Likewise, the design of a rake-cleaning device must be made to suit the particular intake over which the rake operates and these variations are numerous. As brought out in the paper, many variations are made in the design of the rake support to accommodate local conditions. Traveling carriages may roll on

[18] Hydraulic Engineer, Newport News Shipbuilding and Dry Dock Company, Newport News, Va. Mem. A.S.M.E.

[19] U. S. Patent, 1,540,751.

tracks on top of the deck, on the wall of the intake house, or the carriage may even be suspended from hanging supports.

There is no question but that a rake-hoist motor can be too large for the remainder of the hoist machinery. However, as mentioned by Mr. Terry, the rake can be proportioned so that it will trip if it strikes an obstruction near the points of the teeth.

G. T. ABERNATHY.[20]

[20] Hydraulic Division, Newport News Shipbuilding and Dry Dock Company, Newport News, Va.

Army Matériel Inspection

COMMENT BY G. E. CAMPBELL[21]

In addition to the essential qualities for inspectors of army matériel mentioned in the paper,[22] the writer would suggest a sixth qualification, namely, experience in handling of inspection instruments and familiarity with production problems.

Important sources of men qualified in the latter category would be in the machinist trade and from among inspection staffs of manufacturing plants. Undoubtedly, there are many capable machinists who are familiar with tool work, but who have passed the age when they are entirely desirable for production work. Such men have a vast background of experience and would make excellent government inspectors, if given the proper course of specialized training necessary for a specific type of inspection work.

The trend now appears to be to train recent college graduates as inspectors and for other important defense jobs. However bright and ambitious they may be, they do lack the background of experience which can only come from years of operating machines and manufacturing parts. This experience constitutes a natural quality of the older practical artisans, which would seem to the writer to be well worth while and should not be overlooked.

This is offered solely as a suggestion which, without doubt, has already been considered by the Ordnance Department.

COMMENT BY R. L. GOETZENBERGER[23]

Viewing the situation as a reserve officer of the Ordnance Department, who recently took an advanced production and inspection course of training at Watertown Arsenal, and as a manufacturer, who has been concentrating on the negotiation of contracts and the production of Army matériel, I, to a limited extent, feel qualified to discuss the practical application of some of the points reviewed by the author.

As General Case has done, I would place principal emphasis upon inspection because, as the climax of all operations, it exposes both the manufacturer and the Army to the greatest chance of difference of opinion and resultant delays. However, with the hope of overcoming this, the training of Army inspectors now stimulates a cooperative approach which, when brought to the realization of the manufacturer, should inspire not only the best in workmanship but also the promptest deliveries.

It is the job of the inspector to assist in acceptance. This duty has prompted at least one person to suggest the abandonment of the designation "Inspection Division" in favor of "Acceptance Division." There is something about the name "inspector" which connects it with a policeman; a kind of militant authority. The task of an Army Inspector of Ordnance is not measured by the fault that he can find and the quantity of rejections that he can get, but rather, the success of his program depends upon the acceptance of material which will function. With these primary objectives in mind, let us examine some of his routine and from it recognize the importance of manufacturer collaboration.

When the Army Inspector of Ordnance reports to his assignment, he should seek the plant official of highest rank. Upon showing his credentials, he should discuss the contract, at least in so far as inspection is concerned. In his preliminary discussion of plans the necessity of continuous routine inspection by the contractor should be clearly set forth. This will aid in eliminating from the contractor's mind the thought that he can now reduce his own inspection and instead generate the desire to harmonize plant production and government inspection.

Perhaps the most frequent request of an inspector is that of contract alteration. As a manufacturer, confronted with some rather distressing predicaments, resulting from misinterpreted specifications or the desire to substitute materials in order to speed up deliveries, we have learned that the inspector, having had no function in the negotiation of a contract, has no right to alter or suggest changes in one to the contractor. Fighting to keep from violating that rule is one of the major problems of an inspector. However, I can perceive situations which might make the securing of a revision in specifications or in the scope of the contract a responsibility of a manufacturer. In this instance, the case must be cleared through the nearest District Ordnance Office where it is referred to the contracting officer for approval.

In my opinion, neither the Ordnance Department nor industry at large should expect the inspectors, some of whom may have had only a short period of training, to have expert ordnance knowledge. In reality, the inspectors usually are at a disadvantage when trying to match wits with the contractor, who has studied the schedule and started production even before the inspector appeared on the scene. Consequently, the inspector should approach the job with tact and exercise practical judgment, backed by the sense of proportion to which the author alludes so strongly. Under such conditions and with this evident desire to learn, the contractor almost automatically becomes a source of information and assistance to the inspector. Preservation of this cooperative educational mission will be beneficial to both.

It has been our experience to find not only willingness by contracting officers, but also speedy response to requests for aid in order to gain a clear understanding of specifications, drawings, etc., both before and after the arrival of an inspector at our plants. If the problem is a major one, the Arsenals have fulfilled our desire by sending a production expert or methods man to instruct us on the best way to solve it. In the event that acceptance of a device revolves mainly around its final performance, for example, an optical telescope, they have simultaneously instructed the Ordnance and our own inspectors so that both parties may operate from a common basis.

Finally, it seems appropriate to summarize my recollection of the closing challenge of a lecturer in the Watertown Arsenal School for Inspectors by the statement: "You as an inspector will serve your country best by helping the contractor and by conducting your operations so that there may be an uninterrupted flow of supplies which will function effectively in the field. If you can during your service focus your mind on this objective of cooperation, you will avoid many of the pitfalls that would otherwise await you as an Army Inspector of Ordnance."

[21] Chief Engineer in charge of Machinery Design, The Wheland Company, Chattanooga, Tenn. Mem. A.S.M.E.

[22] "Army Matériel Inspection," by R. W. Case, MECHANICAL ENGINEERING, April, 1941, pp. 278–280.

[23] Vice-President, Minneapolis-Honeywell Regulator Company, Philadelphia, Pa. Mem. A.S.M.E.

Colloidal Fuel

COMMENT BY W. L. FAITH[24]

Two major points were brought out in the discussion of this paper.[25] The first was that it might be more economical to set up a plant to burn either coal or oil, or to burn both together from separate burners, as the economic situation demanded, rather than to pay the extra cost for colloidal fuel. This, of course, might be true in a stationary power plant, but it would only apply there. Other advantages such as conservation of storage and burner space would undoubtedly more than offset this added cost in the case of railroad or marine use. Even in stationary plants, the better utilization of low-rank coals is a point which must be considered.

Another point that was brought out was the possible difficulties of atomizing and burning the finished fuel satisfactorily. Unfortunately, we have meager data on the use of the fuel, since we feel it is much more important to determine the actual cost of the fuel before we study these other factors. At the present time, it cannot be said definitely that grinding costs so much, stabilization costs so much, and mixing costs so much, because the study has not been completed. Further technical improvements in these operations should result in cost reduction.

COMMENT BY E. G. SANDERS[26]

The author states: "With cracked residue fuel oils, because of their higher specific gravity and viscosity, no stabilizing agent is necessary unless the fuel is heated to temperatures above 120 F." In another part of the paper it is stated: "It seems likely that mixing might be done more economically by heating the fuel to about 200 F to lower its viscosity." These two statements would indicate that, if the fuel is mixed at a temperature of 200 F without a stabilizing agent, it would be necessary to agitate the fuel by mechanical means to keep the pulverized coal in suspension until the temperature of the fuel dropped below 120 F. It would be interesting to know whether any investigation was made by the author which would confirm or refute this conclusion.

The results of the flowing tests, shown in Fig. 4 of the paper, are informative and indicate that mixtures of cracked residue fuel oil and pulverized coal can be handled through pipes. No mention is made in this paper of the use of stabilizing agents when these flowing tests were made. It is the writer's opinion that, without the aid of stabilizing agents, such mixtures of coal and cracked residue fuel oil may settle in the pipes when handled at temperatures above 120 F. This settling might not take place as long as the fuel was flowing through the pipes, but probably would occur when the flow was stopped with the pipes full of fuel.

The relationship between the viscosity and percentage of coal which may be added to different types of fuel oils is very clearly indicated in Fig. 2. Fuel oils most generally used on oil-burning steam locomotives have viscosities ranging from 200 to 300 sec Furol at 122 F. Fig. 2 would indicate that such oils might have 10 to 20 per cent pulverized coal added, with a resultant Furol viscosity of about 40 sec at 200 to 210 F.

Oil-burning equipment for stationary power plants has been developed for burning very heavy cracked residue fuel oils having Furol viscosities of 1000 sec or above at 122 F. The fuel oil is delivered to the burner at temperatures as high as 275 F. With firing temperatures as high as 275 F, it might be possible to increase materially the percentage of coal which could be mixed with cracked residue fuel oils. It would be desirable if further investigation were made of the viscosity and flowing characteristics of colloidal fuels at temperatures between 210 F and 300 F.

The burning of colloidal fuel in steam-locomotive boilers might necessitate considerable modification of the conventional arrangement used on oil-burning locomotives. The disposal of coal ash and slag residue would be somewhat of a problem, particularly if the slag should be carried over into the flues and adhere to the flue sheet and flues, resulting in a restriction of the draft.

The writer concurs with the author's conclusion that further research and study will be necessary in connection with stability, grinding, mixing, atomizing, and burning colloidal fuel.

COMMENT BY JOHN VAN BRUNT[27]

The author has presented a very interesting description of the preparation of colloidal fuel, including what might be considered a tentative specification of the oils and fineness of coal required for a satisfactory product.

Accepting as an accomplished fact that pulverized coal can be held in suspension in oil, that such a mixture can be pumped, stored, and burned in suitable burners, it has yet to be demonstrated that this can be done economically.

Numerous factors are mentioned in the paper which seem greatly to reduce the probability of successful commercial use. Among these factors are:

1 The necessity of extremely fine grinding, as compared to that required for burning coal alone. Such fine grinding will require predrying for coals of high moisture content, and mill-drying for coals of moderate moisture content.

2 A classifier must be provided to remove the few large particles which would otherwise remain in the finished coal.

3 Suitable collectors or separators must be provided to separate the finished product from the mill air.

This extra fineness must be paid for in increased power consumption and in additional investment for mills. The other equipment just mentioned will also add to the capital cost, as compared to a direct-fired pulverized-coal system.

Apparatus for mixing coal and oil will be required as well as pumps to transport the colloidal fuel to storage bunkers.

A complete plant for such fuel will then consist of all the equipment necessary to burn oil plus all the equipment required to burn pulverized coal and, in addition, the extra equipment previously mentioned. In such a plant, it may be further assumed that the equipment would not limit the plant to the use of colloidal fuel only but that the plant would be so designed that either coal alone or oil alone could be used, whenever economy or expediency should so dictate. Therefore, the cost of oil heaters and pumps would be the same as for a completely oil-fired plant, and the same would be true for the coal-pulverizing equipment. We now have a capital cost for colloidal fuel materially higher than the cost of equipment for burning both coal and oil separately.

As to operating costs, the power for pulverizing will be from 35 to 50 per cent higher than for a direct-fired unit. The mill maintenance would be nearly doubled, and drying a 15 per cent moisture coal would take roughly $1\frac{1}{2}$ to 2 per cent of the coal used. There would be an added pumping cost for transporting the colloidal fuel to the storage bunkers; this in addition to the cost of pumping from the bunkers to the boilers.

It is doubtful if the burning characteristics of colloidal fuel would be superior to that of coal or oil alone. In fact, the contrary would likely be the case.

[24] Head, Department of Chemical Engineering, Kansas State College, Manhattan, Kan.

[25] "Colloidal Fuel," by J. E. Hedrick, MECHANICAL ENGINEERING, August, 1941, pp. 591–594.

[26] Fuel Conservation Engineer, The Atchison, Topeka, and Santa Fe Railway Company, Topeka, Kan.

[27] Charge of Engineering, Combustion Engineering Company, Inc., New York, N. Y. Mem. A.S.M.E.

Henry Kreisinger now research engineer of the writer's company, when connected with the Bureau of Mines, was assigned by the Bureau to follow the experimental work of the Bates development referred to in the paper. Mr. Kreisinger has stated that up to the time the work was dropped after the last war results were unsatisfactory. Trial trips on a boat fired with this fuel were interrupted repeatedly by the fouling of burners and loss of fires.

It is submitted that the most satisfactory and economical method of burning both coal and oil is to burn them separately in combination burners, changing from one fuel to another as desired. Such an arrangement permits the use of either fuel from amounts of 0 to 100 per cent. This permits the operator to take advantage of the market price of either coal or oil, to utilize low-grade bituminous fuels; or, if the price of oil permits, the plant could be switched to oil in a very few minutes.

AUTHOR'S CLOSURE

The question was raised as to whether it would be necessary to agitate the fuel while it is cooling from the mixing temperature of about 200 F to 120 F in order to keep the pulverized coal in suspension. We have mixed a great many samples in the laboratory by heating to 200 F or above and then allowing them to cool. Ordinarily these mixtures will cool quickly enough so that settling is not appreciable. Where large amounts of coal and oil are being mixed, however, some type of flow agitator would have to be used. This would enable the mixture to cool rapidly enough to prevent settling.

Since this paper was written a detailed study has been made of the flow of colloidal fuel in pipes. These data are soon to be published. We have found that oil-coal mixtures can be handled in pipes without any difficulty, even at temperatures considerably above 120 F as long as they are kept moving. When these fuels are allowed to stand in the pipes for several hours some settling takes place. However, we have never encountered a case where the settling was sufficient to plug the pipe, except at very low temperatures.

J. E. HEDRICK.[28]

[28] Department of Chemical Engineering, Kansas State College, Manhattan, Kan.

A.S.M.E. BOILER CODE

Revisions and Addenda to Boiler Construction Code

IT IS the policy of the Boiler Code Committee to receive and consider as promptly as possible any desired revision of the rules and its codes. Any suggestions for revisions or modifications that are approved by the Committee will be recommended for addenda to the code, to be included later in the proper place in the code.

The following proposed revisions have been approved for publication as proposed addenda to the code. They are published below with the corresponding paragraph numbers to identify their locations in the various sections of the code, and are submitted for criticism and approval from anyone interested therein. It is to be noted that a proposed revision of the code should not be considered final until formally adopted by the Council of the Society and issued as pink-colored addenda sheets. Added words are printed in small capitals; words to be deleted are enclosed in brackets [ ]. Communications should be addressed to Secretary of the Boiler Code Committee, 29 West 39th St., New York, N. Y., in order that they may be presented to the Committee for consideration.

The following are proposed revisions of the safety and water-relief valve requirements of the Code for Low-Pressure Heating Boilers.

PAR. H-43 (H-96) Safety Valves. (*a*) Each steam boiler shall have one or more safety valves of the spring-pop type and adjusted and sealed to discharge at a pressure not to exceed 15 lb per sq in. Seals shall be attached in a manner to prevent the valve from being taken apart without breaking the seal. The safety valves shall be arranged so that they cannot be reset to relieve at a higher pressure than the maximum allowable working pressure of the boiler.

(*b*) Each safety valve $^3/_4$ in. or over, used on a steam heating boiler, shall have a substantial device which will positively lift the disk from its seat at least $^1/_{16}$ in. when there is no pressure on the boiler. The seats and disks shall be of suitable material to resist corrosion.

(*c*) No safety valve for a steam boiler shall be smaller than $^3/_4$ in. except in case the boiler and radiating surfaces are a self-contained unit. No safety valve shall be larger than $4^1/_2$ in. The inlet opening shall have an inside diameter approximately equal to, or greater than, the seat diameter.

PAR. H-44 (H-97) Relief Valves. (*a*) Each hot-water heating or hot-water supply boiler shall have one or more relief valves of the diaphragm-operated type, without disk guides below the seat or between the diaphragm and top of seat. The valves shall be set and so arranged that they cannot be reset to relieve at a higher pressure than the maximum allowable working pressure of the boiler.

(*b*) Each relief valve shall have a substantial device which will positively lift the disk from its seat at least $^1/_{16}$ in. when there is no pressure on the boiler.

(*c*) The seats and disks shall be of suitable material to resist corrosion. No materials liable to fail due to deterioration or vulcanization when subjected to any temperature less than 250 F shall be used for any part.

(*d*) No relief valve shall be smaller than $^1/_2$ in. nor larger than 2 in. standard pipe size. The inlet opening shall have an inside diameter approximately equal to, or greater than, the seat diameter.

PAR. H-45 (H-98). Delete.

INSTALLATION OF SAFETY AND RELIEF VALVES

PAR. H-46 (H-99) (*a*). Safety valves shall be connected to boilers, with the spindle vertical if possible, either directly to a tapped or flanged opening in the boiler, to a fitting connected to the boiler by a close nipple, to a "Y" base twin valve connection, to a valveless steam pipe between adjacent boilers.

(*b*) Relief valves shall be connected to the top of boilers, with the spindle vertical if possible, either directly to a tapped opening in the boiler; to a fitting connected to the boiler by a close nipple; to a "Y" base twin-valve connection.

(*c*) When a "Y" base is used the inlet area shall be not less than the combined outlet areas.

When the size of the boiler requires a safety valve larger than $4^1/_2$ in. diameter or a relief valve larger than 2 in. diameter, two or more valves having the required combined capacity shall be used. When two or more valves are used on a boiler, they may be single, directly attached, or mounted on a "Y" base.

PAR. H-47 (H-100). No shut-off of any description shall be placed between the safety or relief valve and the boiler, nor on discharge pipes between such valves and the atmosphere. Safety and relief valves shall not be connected to an internal pipe in the boiler.

PAR. H-48 (H-101). When a discharge pipe is used, its area shall be not less than the area of the valve or aggregate area based on the nominal diameters of the valves with which it connects, and the discharge pipe shall be fitted with an open drain to prevent water from lodging in the upper part of the valve or in the pipe. When an elbow is placed on a safety- or relief-valve discharge pipe, it shall be located close to the valve outlet and the pipe shall be supported so that no undue stress is placed on the valve body. The discharge from safety or relief valves shall be so arranged that there will be no danger of scalding attendants.

PAR. H-49 (H-102). Delete.

PAR. H-50 (H-103). Delete.

DISCHARGE CAPACITIES OF SAFETY AND RELIEF VALVES

PAR. H-51 (H-104) (*a*). Each safety or relief valve shall be plainly marked by the manufacturer in such a way that the markings will not be obliterated in service. The markings may be stamped on the casing, or stamped or cast on a plate or plates securely fastened to the casing, and shall contain the following markings:

(1) The name or identifying trade-mark of manufacturer

(2) Size.....in.
(The pipe size of the inlet)

(3) Pressure.....lb
(The pressure at which it is set to blow)

(4) Capacity.....lb per hour
or
Capacity.....Btu per hour

(5) A.S.M.E. symbol as shown in Fig. H-4

(*b*) Permission to use the symbol designated in the foregoing paragraph will be granted by The American Society of Mechanical Engineers to any manufacturer complying with the provisions of the Code who will agree, upon forms issued by the Society, that any safety valve to which the symbol is applied will be constructed in accordance with the Code and has the capacity stamped upon the valve under the stated conditions, and that he will not misuse or allow others to use the stamp by which the symbol is applied.

(*c*) A steel stamp for applying the symbol may be purchased by such manufacturers from the Society.

(*d*) After obtaining the Code stamp the manufacturer of valves that are to be stamped with the Code symbol shall first submit for testing at least three valves of each of the three representative sizes of each design together with the drawings, at a place where adequate equipment and personnel is available to conduct pressure and relieving capacity tests, which shall be made in the presence of an authorized observer. The place, personnel, and authorized observer shall be approved by the Boiler Code Committee.

(*e*) Tests shall be made to determine the lift, popping and blow down pressures, and capacity of at least three valves of three representative sizes of each design.

Safety valves for steam boilers shall be tested for capacity at 33 1/3 per cent over the 15 lb per sq in. required set pressure.

Relief valves for hot-water boilers shall be tested for capacity at 10 per cent over the 30 lb per sq in. required set pressure.

A coefficient shall be established for each test as follows:

$$\frac{K}{d} = \frac{\text{Actual steam flow}}{\text{Theoretical steam flow}} = \text{Coefficient of discharge}$$

The average coefficient of the tests required shall be taken as the coefficient (K) of the design, and shall be used for determining the relieving capacity of all sizes and pressures of the design in the following formulas:

For 45 deg seat $W = (51.45 \times \pi DLP \times 0.707 \times K)\ 0.90$.

For flat seat $W = (51.45 \times \pi DLP \times K)\ 0.90$.

For nozzle $W = (51.45 \times AP \times K)\ 0.90$.

where W = weight of steam per hour, lb,
D = seat diameter, in.,
L = lift, in.,
P = absolute pressure, lb per sq in.,
K = average coefficient of discharge,
A = nozzle throat area, sq in.

For determining the Btu discharge of relief valve for hot-water boilers, W is multiplied by 1000.

(*f*) The tests shall be made with steam and in a manner closely approximating actual operating conditions of steam boilers. The relieving capacity shall be measured by condensing the steam or with a calibrated steam flowmeter.

These tests shall be conducted in the presence of, and certified by, an authorized observer.

(*g*) A data sheet for each valve tested shall be filled out and signed by the authorized observer witnessing the test. (A sample data sheet report appears as data form H-1.) Such data sheet will be the manufacturer's authority to build and stamp valves of corresponding design and construction. When changes are made in the design similar tests must be repeated.

(*h*) The relieving capacity that may be stamped on the valves shall not exceed 90 per cent of the value determined by the witnessed tests.

(*i*) Delete.

PAR. H-52 (H-105). Delete.

PAR. H-53 (*a*). The minimum size of valve or valves shall be governed by the capacity marking called for in Par. H-68.

(*b*) Delete.

(*c*) The minimum valve capacity in pounds per hour shall be determined by dividing the maximum Btu output at the boiler nozzle obtained by the firing of any fuel, for which the unit is designed by 1000 or by multiplying the square feet of heating surface by 5. In many cases a greater relieving capacity of valves will have to be provided than the minimum specified by these rules. In every case the requirements of (*d*) shall be met.

(*d*) The valve capacity for each boiler shall be such that with the fuel-burning equipment installed, the pressure cannot rise more than 5 lb above the maximum allowable working pressure of a steam boiler and 3 lb above the maximum allowable working pressure of a hot-water boiler.

(*e*) When operating conditions are changed, or additional boiler heating surface is installed, the valve capacity shall be increased, if necessary, to meet the new conditions and be in accordance with (*d*). The additional valves required, because of changed conditions, may be installed on the outlet piping without an intervening valve.

PAR. H-54 (H-107). When a hot-water supply is heated indirectly by steam in a coil or pipe, the pressure of the steam used shall not exceed the safe-working pressure of the hot-water tank and a relief valve of at least 1 in. in diameter, set to relieve at or below the maximum allowable working pressure of the tank, shall be used.

INSPECTION AND STAMPING

PAR. H-68 (*a*). All boilers built according to these rules, and no other boilers, shall be stamped with the symbol as shown in Fig. H-5. In addition, stamping (marking) shall consist of:

(1) Manufacturer's name.

(2) Maximum allowable working pressure.

(3) Capacity (for determining safety valve capacity) showing (*a*) square foot of heating surface), (*b*) 5 lb steam per sq ft, or (*c*) the greatest (maximum) output in Btu per hr (1000 Btu = 1 lb steam).

These markings shall be stamped with letters and figures at least 5/16 in. high in some conspicuous portion of the boiler proper, preferably over or near the firedoor. Where a name plate is used, it is to be of nonferrous material, giving capacity output or other data, and shall be permanently fastened to the boiler or casing, and shall be marked with letters and figures at least 1/8 in. in height.

(*b*) Boilers suitable for use for both steam and water shall have the marking arranged substantially as shown in Fig. H-6. Boilers suitable for use for water only shall have the stamping arranged substantially, as shown in Fig. H-7. Stamping shall not be covered with insulating or other material except that, when a jacket or other form of casing is applied to a boiler, an opening with removable cover may be provided for viewing the required stamping, or the required stamping may be duplicated on the front portion of the casing either on a nonferrous plate, not less than 3 × 4 in. in size, irremovably attached to the casing, or stamped directly thereon.

(*c*) Permission to use the symbol designated in the foregoing paragraph will be granted by the A.S.M.E. to any manufacturer complying with the provisions of this code who will agree, upon forms issued by the Society, that any boiler, to which the symbol is applied, will be constructed in full accordance with the Code requirements and that he will not misuse, nor allow others to use the stamp by which the symbol is applied.

(*d*) A steel stamp for applying the symbol may be purchased by such manufacturer from the Society. No accessory or part of a boiler must be marked "A.S.M.E." or "A.S M.E. Standard" unless so specified in the Code.

PAR. H-106 (*a*). The minimum size of valve or valves shall be governed by the capacity marking called for in Par. H-120.

(*b*) Delete.

(*c*) The minimum valve capacity in pounds per hour shall be determined by dividing the maximum Btu output at the boiler nozzle, obtained by the firing of any fuel for which the unit is designed by 1000. In many cases a greater relieving capacity of valves will have to be provided than the maximum specified by these rules. In every case the requirements of (*d*) shall be met.

(*d*) The valve capacity for each boiler shall be such that with the fuel-burning equipment installed, the pressure cannot rise more than 5 lb above the maximum allowable working

pressure of a steam boiler and 3 lb above the maximum allowable working pressure of a hot-water boiler.

(*e*) When the operating conditions are changed, or additional boiler heating surface is installed, the valve capacity shall be increased, if necessary, to meet the new conditions and be in accordance with (*d*). The additional valves required, on account of changed conditions, may be installed on the outlet piping without an intervening valve.

PAR. H-120 (*a*). All boilers built according to these rules, and no other boilers, shall be either marked, stamped, or cast with the symbol shown in Fig. H-9. In addition, marking shall consist of:

(1) Manufacturer's name or manufacturer's and distributor's name.

(2) The maximum allowable working pressure.

(3) Capacity (for determining safety valve capacity) showing the greatest maximum output in Btu's per hour (1000 Btu = 1 lb steam).

Items (1) and (2) in letters and figures at least $^5/_{16}$ in. high shall be stamped or cast on all of the cored sections. Items (1), (2), and (3) shall be marked on the completed boiler or casing in some conspicuous place with letters and figures at least $^5/_{16}$ in. high. If a name plate is used, it is to be of nonferrous material permanently attached to the boiler or casing, the letters and figures to be not less than $^1/_8$ in. high.

(*b*) Boilers suitable for use for both steam and water shall have marking arranged substantially as shown in Fig. H-10. Boilers suitable for use for water only shall have the marking arranged substantially as shown in Fig. H-11. Stamping shall not be covered with insulating or other material except that when a casing or other form of cover, applied to the boiler, is so arranged that it is not desirable to provide an opening through which the required stamping of the boiler parts may be viewed. The required stamping shall also be placed on a nonferrous plate not less than 3 × 4 in. in size irremovably attached to the front portion of the casing, or it may be stamped in the metal of the casing itself.

(*c*) Permission to use the symbol designated in the foregoing paragraph will be granted by the A.S.M.E. to any manufacturer complying with the provisions of this Code who will agree, upon forms issued by the Society, that any boiler to which the symbol is applied will be constructed in full accordance with the Code requirements and that he will not misuse, or allow others to use, the stamp by which the symbol is applied.

(*d*) A steel stamp for applying the symbol may be purchased by such manufacturer from the Society.

Tables H-6 and H-9. Delete.

FIGS. H-6, H-7, H-10, and H-11 may have to be slightly changed to provide for the revised marking requirements.

Interpretations

THE Boiler Code Committee meets regularly for the purpose of considering communications relative to the Boiler Code. Anyone desiring information on the application of the Code is requested to communicate with the Committee Secretary, 29 West 39th St., New York, N. Y.

The procedure of the Committee in handling the cases is as follows: All inquiries must be in written form before they are accepted for consideration. Copies are then sent by the Secretary of the Committee to all of the members of the Committee. The interpretation, in the form of a reply, is then prepared by the Committee and is passed upon at a regular meeting of the Committee.

This interpretation is later submitted to the Council of The American Society of Mechanical Engineers for approval after which it is issued to the inquirer and also published in MECHANICAL ENGINEERING.

Following is a record of the interpretations of this Committee formulated at the meeting of September 19, 1941, subsequently approved by the Council of The American Society of Mechanical Engineers. Case No. 951 was formulated by the Executive Committee at a meeting on September 30, 1941.

CASE NO. 944

(In the hands of the Committee)

CASE NO. 947 (*In the hands of the Committee*)

CASE NO. 948 (*Special Ruling*)

Inquiry: Is it necessary to radiograph butt-fusion-welded longitudinal and circumferential joints in manholes, sumps, or nozzles fabricated from rolled plate and butt welding flanges, when used on Par. U-68 unfired pressure vessels?

Reply: It is the opinion of the Committee that the Code requires a radiographic examination of all longitudinal fusion-butt-welded joints of manholes, sumps, and nozzles, which are fabricated from rolled plate and used in Par. U-68 unfired pressure vessels. Circumferential butt-welded joints in such attachments not exceeding 10 in. nominal pipe size, or $1^1/_8$ in. wall thickness, need not be radiographed. This provision applies to the fabrication of the attachments themselves and not to the method of attaching them to the vessels.

CASE NO. 949 (*Special Ruling*)

Inquiry: Radiographing is required of all longitudinal and circumferential welded joints in Par. U-68 construction, but is not required for nozzles or pipe connections to the shell except those having flanges butt-welded thereto. If pressure vessels coming within the scope of Par. U-68 construction are formed of pipe or tubular elements, by use of welded circumferential joints, are such joints subject to radiographic examination if the tubular elements do not exceed 10 in. nominal pipe size nor $1^1/_8$ in. wall thickness?

Reply: It is the opinion of the Committee that no radiographic examination is necessary for the welded circumferential joints of such pipe or tubular elements of Par. U-68 pressure vessels provided the materials used conform to Par. U-71, the welded joints therein are stress relieved, and the welding is performed by welding operators who have been qualified in accordance with the qualification requirements in Par. U-68(k).

CASE NO. 950

(Interpretation of Pars. P-102(i) and U-68(i))

Inquiry: (1) The Code states "welds in which the radiographs show porosity shall be judged as acceptable or unacceptable by comparison with the standard set of radiographs." At present the significant films are numbers 3 and 4 which are labeled, respectively, "borderline porosity, acceptable" and "borderline porosity not acceptable." Does this mean that nothing between numbers 3 and 4 is acceptable?

(2) Do the present specifications as to technique, including the use of the Bucky grid on plates 3 in. or more in thickness, apply when the X-ray tube is operated at 1000 kv?

Reply: (1) It is the opinion of the Committee that, for joints having design stresses and safety factors corresponding to the A.S.M.E. Code, number 3 film should be labeled "acceptable" and number 4 film "borderline, not acceptable." This means that any porosity less than that shown on the number 4 film is acceptable.

(2) It is the opinion of the Committee that where 1000 kv X-ray tubes are employed, the present technique specified in the Code, including the use of the Bucky grid on plates 3 in. or more in thickness, should be suspended pending the obtaining of applicable data from experience with these high voltage tubes.

CASE NO. 951 (*Special Ruling*)

Inquiry: Is it permissible to fusion weld boilers of locomotives in accordance with the welding rules of the Power Boiler Code (Section I)?

Reply: Boilers of locomotives may be fabricated by welding, using the welding rules of the Power Boiler Code (Section I), but using plate materials complying with Specifications S-1, S-42, S-43, S-44, S-53, and S-55 now called for in the Code for Boilers of Locomotives (Section III), and following the construction rules of the Code for Boilers of Locomotives.

REVIEWS OF BOOKS

And Notes on Books Received in the Engineering Societies Library

The Engineering Profession

THE ENGINEERING PROFESSION. By Theodore Jesse Hoover and John Charles Lounsbury Fish. Stanford University Press, 1941. Cloth 6 1/8 × 9 in., 441 pp., 29 figs., $5.

REVIEWED BY R. L. SACKETT

"THE Engineering Profession" is the most comprehensive work issued recently on the subject matter, methods and objectives of engineering.

The definition used is: "Engineering is the professional and systematic application of science to the efficient utilization of natural resources to produce wealth." This may be adequate in the early discussion of "Who Is an Engineer?" and "What Is Engineering?" which are the opening chapters and which are good, but it omits the organization of men which is sufficiently important to warrant its inclusion. Later, industrial management receives attention but not in one place as a major factor in modern engineering.

Dean-Emeritus Hoover of Stanford University, formerly head of mining engineering, and Professor-Emeritus Fish, previously head of civil engineering, have written excellent chapters covering the fields of mining and civil engineering.

The chapter on mechanical engineering begins with the discussion of two problems—the production of a piece of tongue-and-groove flooring and "conversion of an invention into a washing machine." They serve to illustrate the sequence of tools from ore to finishing machine and of raw material from standing timber to finished product.

Power generation from heat engines receives only general treatment. The different types of tools, machines, and apparatus are listed.

The importance of personnel and modern methods of selecting men for jobs are slighted. On the other hand, the chapter devoted to mechanical engineering is the longest of those devoted to the description of the different divisions of engineering—40 pages.

It is predicted that in power generation "a decrease in demand may be expected, as fuel-burning plants will lag because of large hydroelectric projects being undertaken by the government." The outlook for mechanical engineers is considered promising in sales, tool, and shop processes, transportation, research, and management.

The chapters covering the other fields are adequate except that more space might be given to chemical engineering which is covered by outlines which condense the treatment.

There are several features of value not included in other similar books. At the end of each chapter describing a division of engineering there are lists of problems needing research, lists of engineering societies related to each field, and a well-selected bibliography of books, bulletins, and periodicals. Historical mileposts and typical curricula for each field are also included.

There are valuable chapters on "The Method of Engineering," "Application of the Engineering Method," "Vocational Guidance in Engineering," "Education of the Engineer," and "The New Call to the Engineering Profession."

The philosophy of the authors is stated in the following extract which appears at the end of the chapter, "Education of the Engineer." "When engineering education includes in parallel fashion the history of society, a training in discovering their interrelations, and also a training in reckoning as consciously with customs, habits, and emotions as with other natural forces, engineers may be expected to cooperate in the advancement of human well-being with the effectiveness they have shown in advancing technology."

Sea Power

SEA POWER IN THE MACHINE AGE. By Bernard Brodie. Princeton University Press, Princeton, N. J., 1941. Cloth, 6 × 9 in., 466 pp., $3.75.

REVIEWED BY H. L. SEWARD[1]

THIS impressive volume has a bale cubic of 91.8 cubic inches and a displacement of 42.1 ounces. Its gross and net tonnages seem to be reasonable because it obviously is well designed.

As the author says in his opening statement, the machine age came late to the navies of the world. Technology once again is revising the power relations of nations, remaking the political map of half the world. The author considers the present changes as merely the culmination of a process of technical change which began more than a hundred years ago. It is with the impact of this process on world political events that this book is primarily concerned. There are five parts: The Steam Warship; The Iron-hulled Warship; Armor versus Great Ordnance; The Torpedo, The Mine, and The Submarine; and Aircraft in Naval War, but the importance of the merchant fleet as an auxiliary to naval strength is not omitted.

To describe at all completely the technological advances in the world's navies since the beginning of the industrial revolution would require an encyclopedia of several volumes. The problem of selection is therefore of paramount importance. Two convenient criteria may be adopted. The first relates to the exclusively naval character of an invention. The machine age has brought into the naval establishments of the world a host of devices, such as the telegraph, both cable and wireless, in the employment of which naval uses remain only incidental. These devices are of great significance in the conduct of war at sea, but since they can scarcely be deemed "naval inventions," they may be excluded from this discussion except for the barest mention. The second criterion is concerned with the relative importance of a technical development. This book considers only the "revolutionary" inventions of the period covered. A host of subsidiary naval innovations which in the aggregate mount up to considerable importance are omitted.

Tactics and strategy are not overlooked or confused. By the former is meant the localized hostilities that occur where adversaries are in contact; the latter refers to those basic dispositions of strength which comprise the entire conduct of a war. A military invention, though de-

[1] Professor of Mechanical and Marine Engineering, Yale University, New Haven, Conn. Mem. A.S.M.E.

signed for a specific tactical effect, may also have strategic consequences. For example, the introduction of steam propulsion very nearly canceled out, as a tactical factor, the influence of the wind, which previousiy had been all-important in battles at sea. It brought not only greater speed to the warship but also a far greater variation in speeds among the different classes of warships. The changes in strategy due to the introduction of the steam warship are due essentially to three factors: (1) Changes in performance of the war vessel comprising increased speeds and independence of wind; (2) the introduction of the fuel problem; and (3) the modification of maritime geography, particularly in the revision of relative distances measured in days of sailing. The remoteness of a region actually depended formerly more on winds than on spatial distance.

The steam merchant vessel changed the whole course of world diplomacy, especially in those vast areas where trade had been hampered by adverse winds. If the Suez Canal hastened the replacement of the sailing ship by the steamer, it is no less true that without the steamship the Canal would not have been cut.

The above very brief glimpse of the hundred pages of Part I may serve to indicate the attitude, style, and resources of the author, so extensively developed in all Parts. As an indicator of the great amount of scholarly search and bibliographical procedure, it is to be noted that few pages of this book are without extensive footnotes to references and authoritative sources.

Seafaring people will be surprised that an author from Chicago, trained in engineering, who served as a forecaster in the U. S. Weather Bureau for the air-mail lines, having become interested in national defense as a National Guard officer in field artillery, was able as a graduate student in international relations to start the job of assembling, correlating, editing, and presenting such a painstaking review of this subject. The only evidence of the absence of salt water in his blood is an occasional lapse into "knots per hour" or "boat" for "ship."

The thoughtful reader in maritime economics and sea power is urged to read this valuable volume.

Books Received in Library

MACHINE TOOLS IN AIRCRAFT PRODUCTION. By R. R. Nolan. Pitman Publishing Corporation, New York, N. Y., and Chicago, Ill., 1941. Cloth, 5 × 8½ in., 158 pp., illus., diagrams, tables, $1.50. It is the purpose of this book to acquaint the vocational student, the beginner, or the young mechanic with the fundamentals of aircraft machine tools and the underlying theory of their application. The more important machine tools and their operations are discussed, and there is a general guide for the selection of machines for various types of aircraft parts.

✓MATHEMATICS (The Pennsylvania State College Industrial Series). By J. W. Breneman. 210 pp., $1.75. MECHANICS (The Pennsylvania State College Industrial Series). By J. W. Breneman. 141 pp., $1.50. STRENGTH OF MATERIALS (The Pennsylvania State College Industrial Series). By J. W. Breneman. 145 pp., $1.50. BLUE PRINT READING AND SKETCHING (The Pennsylvania State College Industrial Series). By H. R. Thayer. 141 pp., $2. McGraw-Hill Book Co., Inc., New York, N. Y., 1941. Cloth, 6 × 9½ in., illus., diagrams, charts, tables. The texts included in this new series are designed to give simplified presentations of the fundamentals of their respective subjects. Intended for the student or apprentice with limited mathematical background, the theoretical treatment is held to a minimum. Stress is laid on the application of principles of these subjects to important practical problems that are common in industry. Further volumes on engineering drawing, machine design, electricity, are to be included in the series.

✓MECHANICAL ENGINEERING PRACTICE, a Laboratory Reference Text. By C. F. Shoop and G. L. Tuve. Third edition. McGraw-Hill Book Co., Inc., New York, N. Y., and London, England, 1941. Cloth, 6 × 9½ in., 506 pp., illus., diagrams, charts, tables, $4. Originally intended as a manual of laboratory practice, this book also provides a comprehensive reference text on experimental mechanical engineering. Major topics covered are: methods and instruments for mechanical measurements, friction and lubrication, heat transfer, properties of gases and vapors, fluid flow, pumps and compressors, steam-power generating units, refrigeration, and internal-combustion engines. The revision includes many laboratory experiments in such newer fields as fluid mechanics and air conditioning.

✓PHOTOELASTICITY, vol. 1. By M. M. Frocht. John Wiley & Sons, Inc., New York, N. Y., and Chapman & Hall, London, England, 1941. Cloth, 6 × 9½ in., 411 pp., illus., diagrams, charts, tables, $6. The two-volume work, of which this text is vol. 1, contains the essential material for a thorough understanding of the theoretical principles and experimental procedures for the exploration of all two-dimensional stress systems by the method of photoelasticity. This first volume is confined to the strictly photoelastic methods for plane stress analysis, which are based entirely on the stress pattern and the isoclinics.

✓PRACTICAL SOLUTION OF TORSIONAL VIBRATION PROBLEMS, vol. 2. By W. K. Wilson. Second edition. John Wiley & Sons, Inc., New York, N. Y., 1941. Cloth, 5½ × 9 in., 694 pp., illus., diagrams, charts, tables, $8.50. Owing to the extensive revision and enlargement of the new edition of this work, it was divided into two volumes. The second volume deals with the determination and measurement of stresses owing to torsional vibration, the analysis of torsiograph records, damping devices and rotating-pendulum vibration absorbers, and the dynamic characteristics of electrical-mechanical direct-coupled systems. Many practical examples are worked out; and an appendix contains a discussion of harmonic analysis, a bibliography, and a selected list of British patents.

✓ PRINCIPLES AND PRACTICE OF HEAT-TREATMENT. By J. Winning. Emmott & Co., Manchester and London, England, 1941. Paper, 5 × 7½ in., 99 pp., illus., diagrams, charts, tables, 2s. This concise, rational account of modern heat-treatment methods and the principles on which they are based is intended for the engineer whose work is affected by heat-treatment problems. The alloys considered have been selected as representative of their particular class as well as being industrially important.

✓PYROMETRY. By W. P. Wood and J. M. Cork. Second edition. McGraw-Hill Book Co., Inc., New York, N. Y., and London, England, 1941. Cloth, 6 × 9½ in., 263 pp., illus., diagrams, charts, tables, $3. This text is designed for a college course in the subject. Introductory material on temperature scales and fluid thermometers precedes the chapters devoted to the description and use of thermoelectric, optical, and total-radiation pyrometers, and resistance thermometers. Temperature recorders and controlling devices are considered, and there is a brief discussion of transition points. Problems and outlines for laboratory experiments are included.

SECOND YEARBOOK OF RESEARCH AND STATISTICAL METHODOLOGY BOOKS AND REVIEWS, edited by O. K. Buros. Gryphon Press, Highland Park, N. J., 1941. Cloth, 7½ × 11 in., 344 pp., $5. This book consists of carefully selected critical reviews of books dealing with statistical methods and techniques in a variety of fields. Three hundred and fifty-nine books published since 1932 are included. The work thus provides a list of the latest publications on the subject and also the means for evaluating them. There are indexes of titles, subjects, and reviewers.

STEEL SQUARE POCKET BOOK. By D. L. Stoddard. Sixth edition, revised and enlarged. Scientific Book Corporation, New York, N. Y., 1941. Cloth 4 × 6 in., 183 pp., diagrams, charts, $1. The practical application of the steel square to many of the problems which must be handled by carpenters and mechanics is clearly described in this small book. Roofs, stairs, and various types of framing are among the topics covered. The use of exact engravings of the square laid on the work simplifies or eliminates otherwise long descriptions.

✓THERMOCHEMICAL CALCULATIONS. By R. R. Wenner. McGraw-Hill Book Co., Inc., New York, N. Y., and London, England, 1941. Cloth, 6 × 9 in., 384 pp., diagrams, charts, tables, $4. A comprehensive introduction is provided to the principles, methods, and data available for the solution of a wide variety of practical laboratory and technological problems. Features of the book are presentations of (1) the fundamental principles of thermodynamics of primary interest to the chemist and chemical engineer; (2) the practical contributions of the theoretical physicist to the field of thermodynamics; and (3) various semi-empirical methods for the estimation of thermodynamic functions of value in solving technical problems.

✓TRANE AIR CONDITIONING MANUAL, published by The Trane Company, La Crosse, Wis., 1941, revised edition. Cloth, 8½ × 11½ in., 376 pp., illus., diagrams, charts, maps, tables, $5. Primarily concerned with the application of the fundamental facts of engineering to the design of air-conditioning systems, this publication touches on all phases of the field. Heat and its transmission, physical comfort, air properties and supply, psychrometry, refrigeration and ventilation processes, the functions of water in air conditioning, and a chapter on ducts and fans, new in this edition, are all covered in this comprehensive treatment of the subject. Diagrams, tables, problems, and numerical examples add to its practical value.

A.S.M.E. NEWS

And Notes on Other Engineering Activities

Four-Point National Defense Theme of 1941 A.S.M.E. Annual Meeting

LAST-minute developments in shaping up the 1941 A.S.M.E. Annual Meeting, to be held at the Hotel Astor, New York, N. Y., Dec. 1–5, reveal significant additions to the program announced in the November issue.

"Lessons Learned From London"

Most important of these features is the four-point National Defense sequence which commences with the luncheon on Tuesday noon at which Walter D. Binger, Commissioner of Borough Works, New York, and chairman of the National Technological Civil Protection Committee, will speak on "Lessons Learned From London." Commissioner Binger, who holds his defense post by reason of appointment of the Secretary of War, was sent to England early in the fall and returned in October, making the trip both ways by bomber via the northern route. In his official capacity and because of his personal observations, Commissioner Binger will speak with authority and from the point of view of an engineer.

Material-Conservation Clinic

A Clinic on the Conservation and Reclamation of Materials Used in Industry will be held on Tuesday evening. The Clinic will answer questions asked by members of the Society and any other persons interested in saving materials and devising methods for salvaging scrap and used articles. Questions are being solicited in advance by canvassing members of the Society. Answers will be prepared in advance by a panel of experts all of whom are men of practical experience in these fields.

The Clinic will be preceded by brief papers giving case histories of conservation and reclamation programs actually in operation in small and large plants. After the background of the subject has been opened up by these papers, the panel of experts will take over. It will be headed by an interlocutor who will put the questions to the members of the panel best qualified to answer them.

Four Phases of National Defense

A National Defense Symposium of four papers by eminent speakers will be conducted on Wednesday morning, at which William A. Hanley, president of the Society, will preside. The papers and speakers scheduled for the symposium are:

"Research for Defense," by Frank B. Jewett, president of the National Academy of Sciences.

"Designing for Defense," by Brig. Gen. G. M. Barnes, Assistant Chief of Industrial Service, Engineering, Ordnance Department, United States Army.

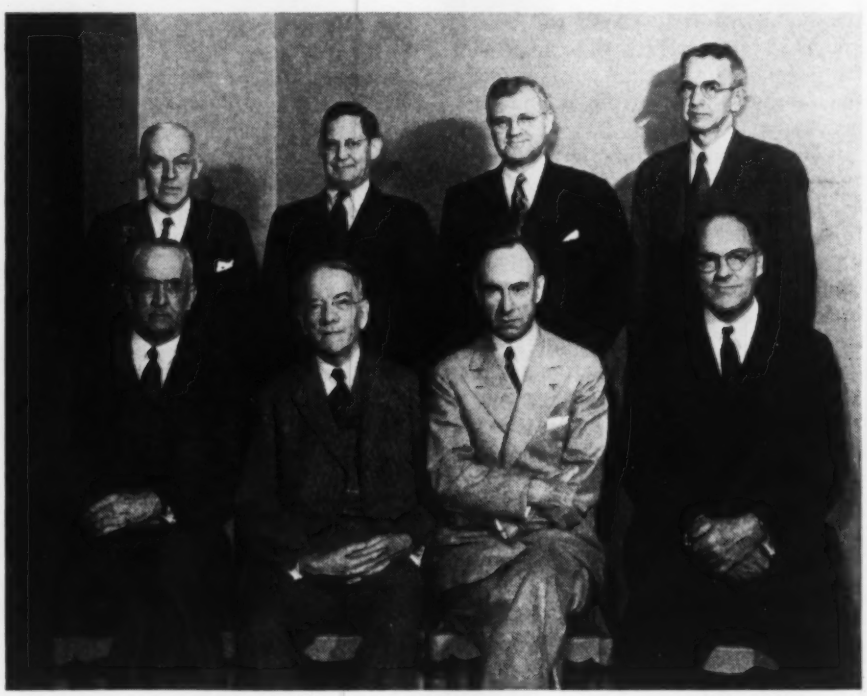
"Invention for Defense," Col. L. B. Lent, chief engineer, National Inventors' Council, Washington, D. C.

"Education for Defense," Dean A. A. Potter, Purdue University, chairman, National Advisory Committee to the Engineering, Science, and Management Defense Training Division, United States Office of Education.

O.P.M. Speakers at Annual Dinner

The climax of the National Defense theme running through the 1941 Annual Meeting will be reached on Wednesday evening when W. L. Batt, past-president A.S.M.E. and head of the Materials Division, O.P.M., will act as toastmaster at the Annual Dinner, at which the principal addresses will be delivered by William A. Hanley, president A.S.M.E., and Donald M. Nelson, executive director, Supply Priorities and Allocations Board, Office for Emergency Management.

At the dinner honorary memberships and awards will be presented, as previously announced. Of national-defense interest will be the honorary memberships conferred on the Honorable Clarence D. Howe, Minister of Munitions and Supply, Canadian Government, Ottawa, Ont., Canada; Rear Admiral Samuel Murray Robinson, U.S.N., Chief of the Bureau of Engineering, U. S. Navy; and Major General Charles Macon Wesson, U. S. Army. Other honorary memberships are to be conferred on Dr. Leon P. Alford, of New York, and Prof. Aurel Stodola, of Zurich, Switzerland. Among the medals to be conferred, especial interest, from a National Defense point of view, lies in the award of the Holley Medal to John C. Garand, Springfield Armory, "for his invention and development of the semiautomatic rifle which bears his name and has been adopted



PRESIDENTS AND SECRETARIES OF THE FOUNDER SOCIETIES AT INDIANAPOLIS, IND., OCT. 11, 1941

(Seated, left to right, Frederick H. Fowler, president A.S.C.E.; Howard N. Eavenson, past-president A.I.M.E.; William A. Hanley, president A.S.M.E., D. C. Prince, president A.I.E.E. Standing, left to right. George T. Seabury, secretary A.S.C.E.; A. B. Parsons, secretary A.I.M.E.; C. E. Davies, secretary A.S.M.E.; H. H. Henline, secretary A.I.E.E.)

by the United States Army; a distinct contribution to our National Defense."

"Work Standardization" Dinner

Under the auspices of the Work Standardization Committee of the Management Division a Work Standardization Dinner will be held in the Columbia Room of the Hotel Astor on Monday evening at 6:30 p.m.

Paper on Supercharger Added

An important paper entitled "Energy Transfer Between a Fluid and a Rotor for Pump and Turbine Machinery," by Sanford A. Moss, Chester W. Smith, and William R. Foote, has been added to the list since the preliminary program was announced in the November issue of MECHANICAL ENGINEERING. The paper is contributed by the Aviation, Hydraulic, and Power Divisions and will be presented on Tuesday evening. It presents an analytical treatment of the energy transfer between a working fluid and a rotor for pump and turbine machinery. The generalized treatment is made specific for such cases as the supercharger, the centrifugal pump, and all kinds of steam, gas, and hydraulic turbines.

Defense Production Featured

The Machine Shop Practice Division will also sponsor a session on Wednesday afternoon featuring defense production, at which two important papers will be presented. Col. H. F. Safford, of Watervliet Arsenal, will speak on "New Developments in the Manufacture of Cannon," and H. E. Linsley will talk on "Transfer Machines at the Cincinnati Plant of the Wright Aeronautical Company."

Ambassador Winant Addresses Mechanical Engineers in London

Guest of Honor at Luncheon of I.M.E.

WORD has been received of a luncheon of The Institution of Mechanical Engineers, held at Grosvenor House, Park Lane, London, on September 19, at which His Excellency John G. Winant, the American Ambassador, was the guest of honor. The following account of the luncheon and the address by Ambassador Winant was reported by J. E. Montgomery, secretary I.M.E., in a letter to C. E. Davies, secretary A.S.M.E.

"It was the first social function on a large scale which we had attempted to hold since the outbreak of war, and in view of the fact that the wives of our members had not had the usual opportunity afforded by our Summer Meetings of making contact with each other, the Council decided on this occasion to invite lady guests. As a result we had a record attendance of nearly one thousand, and had to refuse several hundred for whom accommodation was not available.

"We had an imposing top table, comprising in addition to Mr. Winant, Mr. A. V. Alexander (the First Lord of the Admiralty) who was a principal speaker, the heads of the Fighting Services, and representatives of most of the Government Departments, kindred Institutions, etc.

"I think you may like to see the following report of what Mr. Winant said in responding to the Toast of the Guests, which I give to you verbatim:

> "His Excellency JOHN G. WINANT, American Ambassador, who was received with prolonged cheering on rising to reply, said: 'I should like to say a word for myself and for the other guests here in appreciation of the hospitality that you have accorded us. You already know the contribution that has been made by the engineer in England, in Russia, and in the United States, both in peacetime and now again in wartime. The president has said that it was your intention to journey to my country just prior to the war's breaking out, in order to join with engineers there in discussing the problems of constructive engineering. I hope that you will make that journey when the war is over. You may not be able to go collectively, but individually, by letter and in person, you can still do great service both to your own country and to mine if you continue to communicate with the engineers of the United States. (*Applause*)
>
> 'Only last week, three or four of our most able industrialists came over here to find out what things we might make successfully in the United States that you are at present making here, and also what we are doing for you in the United States that you can more successfully and effectively do here. There is no group of people in England who could be more useful to those men than you who are gathered here today.
>
> 'Only in our combined effort will we find success. We must multiply machine power and place it behind man power, behind the soldiers of liberty and freedom and fair play. (*Applause*)
>
> 'I do not know the customs of your country, nor exactly what a guest in responding to the toast of the guests should do, and if in my ignorance I transgress, I hope you will forgive me. Some years ago an intelligent educator said that as civilization progressed we have come to realize that intelligence counts for more than brute force, that organization counts for more than intelligence, but that devoted self-sacrifice counts for most of all. (*Applause*) Democratic government gives every individual the privilege and the opportunity of devoted self-sacrifice. In my brief stay here, I have met many men and women. I have tried to meet all the people, and not just a few of the people. You know that I have a deep respect for you and for your courage and fortitude. I have met three men here, however, who are responsible for organization, and intelligent organization, who are all qualified to be engineers, who are completely selfless and who know the full measure of devoted self-sacrifice. They are the men who head your three Services; and, if a guest replying for the guests may propose a toast, I should like to propose the toast of Sir Dudley Pound, Sir John Dill, and Sir Charles Portal.' (*Prolonged applause*)

"Acting on Mr. Winant's admirable suggestion of continued contact with the engineers in the United States (which you will see was greeted with loud applause) our president forthwith sent the following cablegram to your president, which I hope was safely received:"

> PRESIDENT AMERICAN SOCIETY OF MECHANICAL ENGINEERS NEW YORK
>
> ON OCCASION OF INSTITUTION LUNCHEON WITH YOUR AMBASSADOR AS CHIEF GUEST SEND YOU AND YOUR MEMBERS WARMEST GREETINGS AND GOD SPEED COMMON EFFORT
>
> INSTITUTION MECHANICAL ENGINEERS LONDON

E.I.C. Announces 1942 Annual Meeting

THE Council of The Engineering Institute of Canada announces that the Fifty-Sixth Annual and General Professional Meeting will be held in Montreal, Feb. 5 and 6, 1942.

It is planned that the papers and discussions shall all bear on the central theme of the engineers' participation in war industry, with particular reference to those articles of warfare being manufactured in Canada for the first time. It is also expected that some time will be spent in discussing the engineering phases of Air Raid Precautions (A.R.P.).

A.S.M.E. Calendar

of Coming Meetings

December 1–5, 1941
Annual Meeting
New York, N. Y.

March 23–25, 1942
Spring Meeting
Houston, Texas

June 8–10, 1942
Semi-Annual Meeting
Cleveland, Ohio

June 17–19, 1942
Oil and Gas Power Division
Peoria, Ill.

October 12–14, 1942
Fall Meeting
Rochester, N. Y.

(*For coming meetings of other organizations see page 22 of the advertising section of this issue*)

300 Attend Fifth Annual Joint Fuels Conference at Easton on "Better Utilization of Coal"

CHAIRMEN Paul B. Eaton, A.S.M.E., and W. B. Plank, A.I.M.E., of the Local Arrangements Committee for the Fifth Annual Joint Fuels Conference of The American Society of Mechanical Engineers and the American Institute of Mining and Metallurgical Engineers, welcomed approximately 300 members and guests of the two Founder Societies to Easton, Pa., for a three-day session beginning Thursday, October 30.

Dr. William Mather Lewis, president of Lafayette College, opened the Conference with a welcoming address in which he pointed out that nations without fuel resources are recognizable as those which are economically in the lower ranks, whereas such nations as ours with large fuels resources are high in the economic standing of nations. He paid tribute to the efforts of the fuel engineers for the conservation of our resources at this time of emergency and recognized the value of joint conferences, of which this was the fifth, in promoting between producer and consumer a better understanding of mutual problems.

William G. Christy, smoke-abatement engineer, Hudson County, N. J., and chairman of the Fuels Division, A.S.M.E., responded as host chairman for the A.S.M.E. J. E. Tobey, vice-president in charge of fuel engineering of Appalachian Coals, Incorporated, and chairman of the Coal Division, A.I.M.E., responded for the mining engineers.

Courtesy Easton Express

PRESENTATION OF GAVELS AT FUELS CONFERENCE

(Prof. William B. Plank, left, presents gavel to Julian E. Tobey, chairman of the Coal Division of the American Institute of Mining and Metallurgical Engineers, as Prof. Paul B. Eaton, extreme right, presents the other gavel to William G. Christy, chairman of the Fuels Division of The American Society of Mechanical Engineers.)

Mine Fires and Domestic Stokers

The first session, under the chairmanship of Henry F. Hebley, program chairman of the Coal Division, and A. W. Thorson, program chairman of the Fuels Division, listened to two papers during the morning.

In what was probably the first application of the scientific approach to the problems of anthracite mine fires, C. S. Scott presented the report by O. W. Jones and himself, both of the U. S. Bureau of Mines, on the application of chemistry to anthracite-mine fire problems. Mr. Scott pointed out that the importance of the bacteria living in mine waters in changing the composition of the gases under certain conditions of fire was great enough to make it necessary to consider them in any formulation of the controlling conditions affecting mine fires. Although the report was not intended to be final, the information offered was of great value as well as interest to the Conference.

Walter Knox, of the research department of Koppers Company presented the second paper on domestic stoker coal research which he had written in collaboration with J. D. Doherty, research engineer of the Koppers Coal Company. With the paper was presented an extremely interesting photographic analysis of the operation of domestic stokers burning soft coal. With the action speeded up by intermittent exposure and continuous projection, it was possible to watch the rapid growth of the coke trees and their combustion in a matter of seconds on the screen although the action took hours and even days under operating conditions. Many different conditions of operation with respect to load and off and on periods, as well as hold fire conditions, were very successfully illustrated.

The Conference was a guest of the local Rotary at a luncheon on Thursday in which Mayor Joseph Morrison welcomed the members of the Conference officially to the city and extended the courtesies of the city to them. Mayor Morrison's talk was followed by a demonstration by the Bell Telephone Company representatives of its research on the better transmission of speech through telephones.

Two Symposiums on Fuel-Burning Equipment

In the afternoon, under the chairmanship of J. E. Tobey and R. M. Hardgrove of The Babcock and Wilcox Company, a symposium on the Adjustment of Pulverized-Fuel-Burning Equipment was presented under the sponsorship of the Joint Committee on the Solid Fuel Test Code. Henry Kreisinger, of the Combustion Engineering Company, A. C. Foster, of the Foster Wheeler Corporation, F. G. Ely, of The Babcock and Wilcox Company, and Ollison Craig, of the Riley Stoker Company, represented by F. G. Treat, presented information as to how their respective companies met the problems of different fuels in the field and the problems of starting new units.

At an informal dinner just before the evening session, with Professor Eaton presiding, the Conference was shown motion pictures of the combustion of small sizes of anthracite on household stokers illustrating the factors which made for good combustion or for troublesome conditions.

In the evening again under the sponsorship of the Joint Committee on Solid Fuel Test Code, a second symposium was presented under the chairmanship of J. E. Tobey and Martin A. Mayers, of the Coal Research Laboratory. This symposium was on the subject of the adjustment of underfeed-stoker-fired equipment and was participated in by George P. Jackson, of Combustion Engineering Company, J. S. Bennett, 3rd, of the American Engineering Company, and Frank Scott of the Westinghouse Electric and Manufacturing Company. The presentation of information on stoker adjustments led to long discussion of the many factors involved and emphasized the large share that stokers still play in the combustion of fuel under boilers. This session continued until 11:30 p.m. and had to be closed without all present having had an opportunity to offer their discussion.

Mine Roof and Burning Controls

On Friday morning, H. D. Greenwald presented a paper by I. Hartmann and himself, both of the U. S. Bureau of Mines' Experimental Station at Pittsburgh, on the "Effect of Changes of Moisture and Temperature on Mine Roof." This session was under the cochairmanship of David R. Mitchell, of the Coal Division, and L. A. Shipman, fuel engineer of the Southern Coal and Coke Company. In this paper the surprising expansion and contraction of the mine-roof materials were reported. The paper was based on tests of sections of the mine roof exposed to different temperature and humidity conditions under laboratory control. These sections demon-

strated that the expansion was rapid enough under certain conditions of humidity changes to create stresses in the material which caused failure and consequent falls of the roof. Protection of roofing by guniting or asphalt-base paint was indicated as having highly satisfactory results. In the second paper, W. E. Reaser, of Lafayette, presented an analysis of the development of automatic control as applied to rotary cement kilns. Professor Reaser indicated the early conditions of simple and somewhat ineffective control and compared them with the conditions existing today under the complete control such as he proposed.

The Conference had luncheon in the gymnasium of Lafayette College with Professor Plank presiding. Dean Distler, of Lafayette, welcomed the Conference to the College and turned the program over to Prof. Thomas E. Yerger in charge of music who entertained with instrumental and vocal selections by the musical clubs of Lafayette College. The success of the singers and instrumentalists was demonstrated by the energetic applause given by the Conference.

The fifth session of the Conference took place in Pardee Hall of the College under the chairmanship of Messrs. Christy and Hebley. J. H. Kerrick, of the Philadelphia and Reading Coal and Iron Company, presented the first paper on the "Performance of Industrial Chain-Grate Stokers." Mr. Kerrick described the modern stoker installations burning washed culm successfully.

The second paper was presented by C. H. Frick, plant-betterment engineer of the Pennsylvania Light and Power Company on "Burning of Pulverized Anthracite in Steam Power Plants." Mr. Frick made an important contribution to the literature by submitting records of the changes which have occurred and the efficiency with which anthracite has been burned in the pulverized form over the last decade or two.

E. G. Bailey Speaks at Banquet

Dean A. C. Callen, of Lehigh University, presided at the banquet on Friday evening at which E. G. Bailey, of The Babcock and Wilcox Company, gave the principal address. Mr. Bailey chose for his subject the theme of the meeting which was "Better Utilization of Coal."

Mr. Bailey, whose speech was broadcast, grouped the users of fuel into classes and pointed out the amount of fuel now used in each class together with the savings which had been made. Mr. Bailey prophesied that there would be ultimately a disappearance from the market of the larger sizes of prepared solid fuels and an increase in the use of fine sizes, with corresponding price changes in order to cover the cost of mining and preparation. Mr. Bailey based his prediction on the feeling that he has that solid fuels must approach a fluid condition in order to compete successfully with gaseous and liquid fuels.

The guests at the banquet were then entertained by motion pictures presented by Clarence G. Hamel, representing the Consolidated Edison Company of New York, Inc., showing the performance of several coals on each of two different stokers. Mr. Hamel pointed out that although the over-all steam-generating results were comparable, the process of combustion was affected in quite different manners by the two stoker mechanisms. Mr. Hamel also showed some motion pictures made in an attempt to study the disruption of a fuel bed based on small sizes of anthracite burning on a chain-grate stoker when the active burning was concentrated largely in one zone.

Power Plants and Cement Mills Visited

Through the courtesy of local industries, some souvenir data books or watch fobs were found at each seat of the banquet tables.

On Saturday, four interesting trips had been arranged by the local committee to visit industries in or near Easton. These trips included a visit to the Alpha and the Lehigh Cement companies plants illustrating the dry process and the wet process of manufacture, respectively. Pulverized anthracite was shown by a trip to the Riegel Paper Company. Through the courtesy of the Lehigh Coal and Navigation Company at near-by Lansford, the mining of anthracite was shown and followed by a visit to the pulverized-anthracite-burning plant of the Pennsylvania Power and Light Company. Pulverized bituminous was shown at the Gilbert Station of the New Jersey Power and Light Company. Complimentary lunches were served by the host companies.—A. R. MUMFORD.

A.S.M.E. Executive Committee Meets in Louisville, Oct. 12

THE Executive Committee of the Council of The American Society of Mechanical Engineers met at the Brown Hotel, Louisville, Ky., on Oct. 12, 1941, in connection with the 1941 Fall Meeting of the Society. There were present at the morning session, W. A. Hanley, president, Kenneth H. Condit, K. M. Irwin, Clarke Freeman, A. G. Christie, James H. Herron, Samuel B. Earle, Joseph W. Eshelman, and Linn Helander; C. E. Davies, secretary; and Otto Krause, Junior observer. At the afternoon session there were present, in addition to those who attended the morning session, Guy T. Shoemaker, Huber O. Croft, W. David Wuest (Junior observer), and I. E. Moultrop and H. H. Snelling, guests.

The following actions of general interest were taken.

Founder Society Presidents and Secretaries Conference

Mr. Hanley reported that on October 11 the presidents and secretaries of the Founder Societies had held a conference at Indianapolis, Ind. It had been agreed at this conference that a Joint Conference Committee of presidents and secretaries of the Founder Societies should be instituted to discuss from time to time matters of common interest. Accordingly, such a Joint Conference Committee was organized by electing the president of The American Society of Mechanical Engineers as chairman, the president of the American Institute of Electrical Engineers as vice-chairman, and the secretary of the Institute of Electrical Engineers, secretary.

The Joint Conference Committee recommended the appointment by each of the Founder Societies of one representative each to advise on and develop a policy on Inter-American Cooperation. As a result of this recommendation the Executive Committee of the A.S.M.E. Council authorized the president to appoint such a representative.

At the Joint Conference Committee meeting, D. C. Prince, president A.I.E.E., presented interesting comments on the subject of post-war planning which he is discussing before sections of the A.I.E.E. On the recommendation of the Joint Conference Committee, the Executive Committee of the A.S.M.E. voted to authorize the president to appoint an

AFTER THE DINNER ON TUESDAY NIGHT, OCTOBER 14, DURING THE A.S.M.E. FALL MEETING, LOUISVILLE, KY.

(*Left to right:* William F. Lucas, Mrs. William F. Lucas, Don Bergman, Ford L. Wilkinson, Jr., Elmer J. Dreyer, Mrs. John K. Meyer, John K. Meyer, Mrs. Melvin Sack, and Melvin Sack.)

A.S.M.E. representative on a joint committee on postemergency planning.

Greetings From I.M.E.

Greetings from The Institution of Mechanical Engineers (Great Britain) on the occasion of a luncheon to the American Ambassador in London, Sept. 19, 1941, were read by the Secretary. (An account of this luncheon will be found on page 927 of this issue.)

Gift From Ervin M. Fitz

The gift of a poster of the Hanover Foundry and Threshing Machine Company, dated 1841, from Ervin M. Fitz, was reported. A reproduction of the poster appeared in the October, 1941, issue of MECHANICAL ENGINEERING, the original having been deposited in the Engineering Societies Library.

Appointments and Standards

The following appointments were reported: PTC Committee No. 20, Speed Temperature and Pressure Responsive Governors, Herbert Estrada; Special Research Committees on Forging of Steel Shells, John Dierbeck, W. M. Frame, A. F. Macconochie, A. Nádai, George Sachs, M. D. Stone, W. Trinks, A. E. Van Cleve, A. H. Bateman, H. U. Wagner, J. H. Frye, R. M. Wood, W. N. Howley, and Fred C. MacDonald.

Record was made of Council approval, by letter-ballot as a standard of the Society, and for transmission to the American Standards Association, of Revisions of American Standards for (1) Letter Symbols for Hydraulics, (2) Letter Symbols for Mechanics of Solid Bodies.

Research Committee on Furnace Performance Factors

On recommendation of the Research Committee the Executive Committee of the A.S.M.E. Council voted to authorize a Special Research Committee on Furnace Performance Factors with two subcommittees, No. 1 on Heat Transfer in Furnaces and No. 2 on Properties of Fuel Ash and Slag.

The personnel of the special Research Committee on Furnace Performance Factors appointed is as follows: A. R. Mumford, chairman, Alex D. Bailey, John Blizard, S. P. Burke, O. F. Campbell, W. A. Carter, B. J. Cross, Thomas B. Drew, F. G. Ely, A. C. Fieldner, James H. Harlow, H. C. Hottel, Elmer L. Lindseth, W. H. McAdams, Percy Nicholls, E. B. Powell, Allen A. Raymond, Ralph A. Sherman, Philip Sporn, and W. J. Wohlenberg.

R. E. Doherty Invited to Speak on E.C.P.D.

R. E. Doherty, chairman E.C.P.D., was invited to address the Business Meeting of the Society, New York, N. Y., Dec. 1, 1941, on the plans of E.C.P.D.

Society Aims and Objectives

The secretary reported that comments on "Aims and Objects of the Society," by W. F. Durand, which appeared in the September, 1941, issue of MECHANICAL ENGINEERING had been received from Chas. F. Scott and Gregory M. Dexter. (These comments will be found on pages 914–916 of this issue.)

SPEAKERS AT THE SYMPOSIUM ON WOOD AND PLYWOOD IN THE DEFENSE PROGRAM HELD AT THE FALL MEETING, LOUISVILLE, KY., OCT. 12–15, OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

(Left to right: Charles B. Norris, chairman A.S.M.E. Wood Industries Division; Armen S. Kurkjian, member A.S.M.E., Oliver Machinery Co.; Thomas D. Perry, chairman of the Committee on Use of Plywood as an Engineering Material, A.S.M.E. Wood Industries Division, who arranged the symposium; S. Paul Johnston, research coordinator, N.A.C.A.; James J. Dunne, U. S. Plywood Corp.; Richard G. Kimbell, director of technical service, National Lumber Mfrs. Assn.; and A. J. Stamm, Forest Products Laboratory.)

Engineering Societies Library Director Reports for 1940-1941

"LIBRARIES, in common with other institutions," says Harrison W. Craver, director, Engineering Societies Library, New York, N. Y., in his annual report to the Library Board, "are sensitive to unusual social and economic conditions, and find their activities much affected by those of the present day. The extraordinary changes that are occurring in manufacturing and industry have resulted in constant appeals to us for material on shipbuilding, the manufacture of munitions and aircraft, and on other questions connected with the defense program.

"It is interesting to note that many questions have come from engineers who have had to turn their attention to matters outside their ordinary fields of work, and who refer to us for help in acquiring quickly some basic knowledge of unfamiliar matters. It has been a pleasure to respond to these applicants and to guide them to the best texts available.

"As a means of making such information widely useful, your Director was asked by the American Library Association to prepare a brief select list of books on defense topics which might serve as a guide to American public libraries. This list, "Engineering Defense Training," compiled with the assistance of the chief bibliographer, Harrison A. von Urff, was published in October, 1940, and widely distributed.

"The absorption of many young men by the military forces and the intensified training given by the colleges have apparently affected the number of students using the library. Judging by our experience, there has also been considerable interruption of schemes of long-plan research work.

Statistics

"Statistically stated, the library has had 25,537 readers, and has served 10,259 users in other ways. Searches were supplied to 84 persons and translations to 52. For 2646 persons there were made 24,752 photoprints and 31 microfilm copies. Books were lent to 474 members. Telephone calls for help numbered 5274, and inquiries by mail were 1698.

"In these various ways the library served 35,796 members and their firms, as compared with 40,576 in 1939-1940. The reduction in visitors (4644) accounted for most of the decrease; the remainder is scattered through the various services.

"The adoption of more liberal terms of loan to members has resulted in a gratifying increase (one hundred and twenty per cent) in the number assisted in this way. Where definite treatises were wanted, we have been able to provide them in nearly every case. It is hoped that this use will continue to grow.

Acquisitions

"Troubled times have had an effect upon acquisitions. The uncertainty of communications, the stoppage of publication in many countries of Europe, destruction in transit and, finally, the inability to transmit money, have all affected receipts from other lands. As a consequence, only 11,032 books, pamphlets,

etc., were received as compared with 18,415 in the preceding year.

"Much of this material came as gifts and, as in other years, many gifts duplicated books already on the shelves, while others were not worthy of preservation. However, in spite of lessened receipts, the additions to the permanent collections were 5900 books, pamphlets, and maps; a number slightly above that (5716) of the year before.

"Success in maintaining files of foreign periodicals has been gratifying. Receipts from Germany and the unoccupied lands have been fairly regular, although frequently much delayed. It is surmised that publication of many journals in the occupied lands has ceased, at least temporarily, but definite information cannot be obtained at present. The number of current periodicals received was 1124.

"During the year 486 new publications were reviewed by the staff in the journals of the Founder Societies and The Engineering Institute of Canada. These volumes included the best publications on engineering and the list published in the society journals called them to the attention of members in a convenient manner. The works have all been added to the library. Their market value, about fifteen hundred dollars, covered the expense of reviewing them.

"The library continues to benefit by numerous gifts from many members and other friends.

Book Stock

"The permanent additions to the library consisted of 2720 books, 160 maps, 3001 pamphlets, and 19 searches bringing the total stock to 152,263 books, 7755 maps, and 4492 searches, or 164,510 items. The number of titles (individual works) represented by this figure is 88,263.

"Because the library is the constant recipient of gifts, it accumulates large numbers of duplicate volumes. Sales are made from this stock at every opportunity, but as storage space is limited and sales are infrequent, the stock from time to time becomes embarrassingly large.

"It was therefore decided, last fall, to offer to present certain portions of the collection to other libraries. Advantage was taken of this offer by a number of engineering colleges and libraries of local sections, to which some 3500 volumes were presented. The duplicates on hand comprise 23,500 books and pamphlets. Receipts from sales during the year were $1422.35.

Periodical Index

"Continued progress has been made in the classed index to periodical literature, to which approximately 20,000 cards were added, bringing the total entries to 256,000 articles published during the last thirteen years.

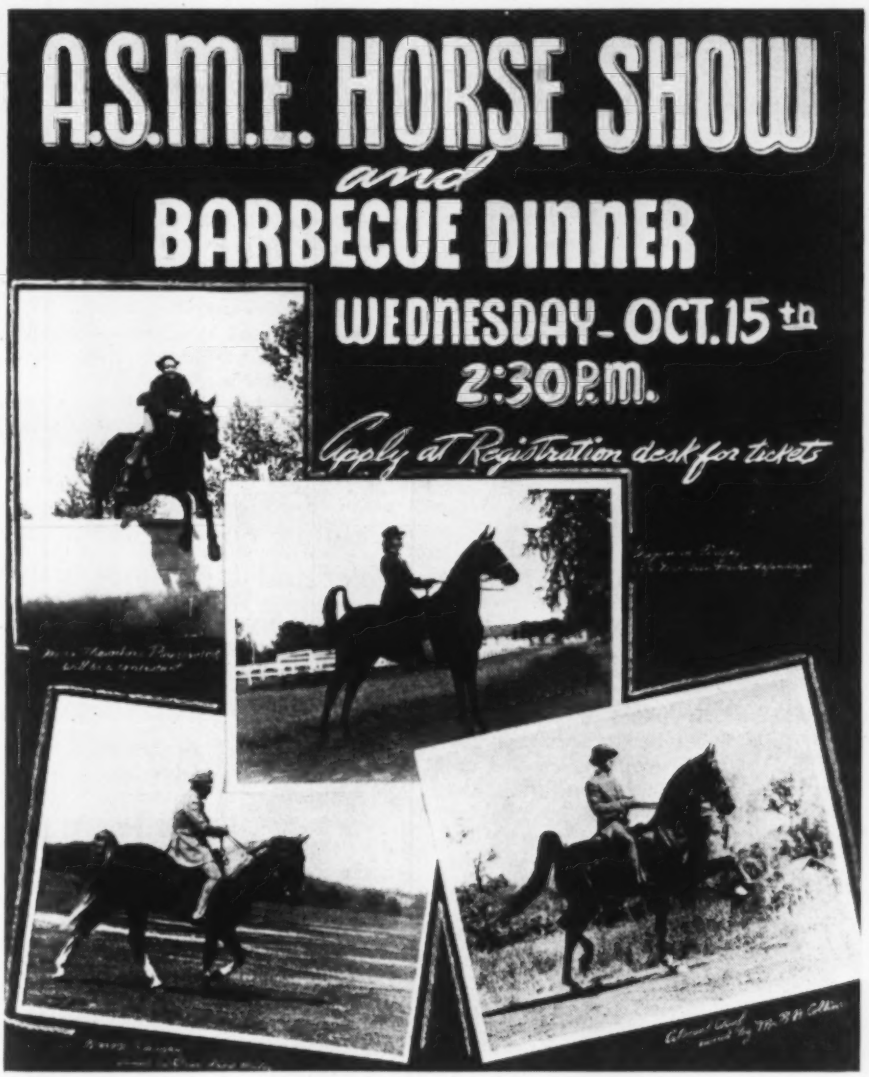
Finances

"The budget appropriated for general operation was $48,400. Of this amount $37,062.80 was provided by the Founder Societies on a membership basis as follows:

American Society of Civil Engineers	$ 9,840.20
American Institute of Mining and Metallurgical Engineers	7,885.10
The American Society of Mechanical Engineers	9,265.40
American Institute of Electrical Engineers	10,072.10

"Expenditures from this budget were $45,763.72 of which $7,764.30 was spent for books and other equipment of permanent value.

"The Service Bureau received $9,281.71 in payment for searches, translations, and copies, and spent $7,426.40."



Poster Displayed at A.S.M.E. Fall Meeting in Louisville, Ky., to Announce Horse Show

ONE of the most delightful events of the A.S.M.E. Fall Meeting held in Louisville in October was the Horse Show held in conjunction with a barbeque dinner at the famous Rock Creek Riding Club.

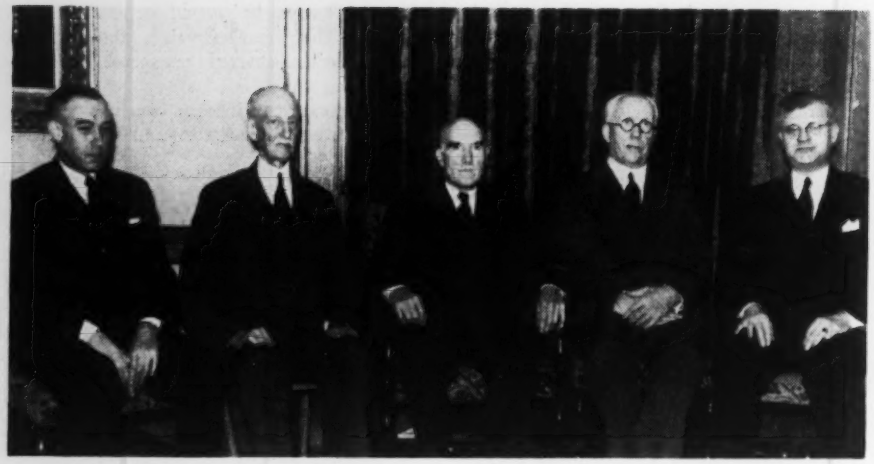
The judge of the show was Robert Jones of North Middletown, Ky., well known throughout the United States for his ability in this field. Ring Marshal was J. B. O'Brien, Ring Clerk, Mrs. C. H. Fleming, and Announcer, F. W. Curran, all of Louisville.

The original of this poster stood over three feet high and was made of royal blue cardboard with the lettering in white and actual photographs of the contestants arranged as shown. It caused much favorable comment for its attractiveness and there were very few at the Meeting who did not stay until the last day to be able to attend the Horse Show and the barbeque.

Films on Motion and Time Study Available

THE *University of Iowa Extension Bulletin*, No. 518, October 15, 1941, describes briefly the Industrial Engineering Film Library of motion- and time-study films that are available for loan to industry and educational institutions.

A copy of Bulletin No. 518, which lists more than two dozen films, with titles, footage, and rental charges, will be sent on request to the Department of Visual Instruction, University of Iowa, Iowa City, Iowa.



NEW OFFICERS OF A.S.M.E. BOILER CODE COMMITTEE
(Left to right: H. E. Aldrich, D. S. Jacobus, E. R. Fish, H. B. Oatley, and C. E. Davies.)

A.S.M.E. Boiler Code Committee Elects New Officers

THE A.S.M.E. Boiler Code Committee at its meeting on October 31, 1941, elected Edwards R. Fish, chief engineer, Boiler Division, Hartford Steam Boiler Inspection and Insurance Company, Hartford, Conn., as its new chairman, Dr. D. S. Jacobus, the former chairman having resigned the chairmanship. Mr. Fish will be the fourth chairman of the committee since its appointment by the Council of the Society in 1911. His predecessors were John A. Stevens, Fred R. Low, and D. S. Jacobus.

Other officers elected were Henry B. Oatley, vice-president, The Superheater Co., New York, N. Y., as vice-chairman and member of the Executive Committee.

Doctor Jacobus, the retiring chairman, is to continue his membership on the committee and will serve as the chairman of the Executive Committee, of which Henry E. Aldrich is vice-chairman. He was also elected honorary chairman of the committee. Doctor Jacobus was a member of the Advisory Committee to the Boiler Code Committee in 1911, and was appointed a member of the Main Committee in 1915. He has served as chairman of the Executive Committee since 1917, and chairman of the Boiler Code Committee since 1936.

The newly elected chairman, Mr. Fish, has been a member of the committee since 1918, a member of the Executive Committee since 1922, and has served as vice-chairman of the committee since 1936. He is the chairman of the Subcommittee on Unfired Pressure Vessels and the Special Committee to Revise Section VIII of the Code.

Mr. Oatley, the newly elected vice-chairman of the committee, has been a member of the committee since 1930 and is a member of the Subcommittees on Boilers of Locomotives and on Nonferrous Materials. He is now serving as chairman of the latter committee.

Dr. Julian W. Shields, formerly of the Chicago Bridge and Iron Co., Chicago, Ill., has been added to the A.S.M.E. Technical Committees staff as Secretary to the Boiler Code Committee.

The A.S.M.E. Boiler Code Committee was appointed for the purpose of formulating rules for the construction of boilers and pressure vessels and for their care in service. It meets at regular intervals for the purpose of considering inquiries relative to the Boiler Code. Revisions and the adoption of new rules are also given consideration at regular intervals to provide for progress in the art and the use of other materials. The interpretations and revisions of the Code are published in MECHANICAL ENGINEERING for study and consideration by all interested parties.

Institute for Applied Mathematics at New York University

WITH a view toward serving not only the needs of the present emergency but also those of future reconstruction and development, New York University has announced establishment of an Institute for Applied Mathematics. In conducting the activities of this Institute, cooperation with other educational and technical institutions is planned. During the academic year 1941-1942, the offerings of the Institute will fall into two categories, one on a permanent, the other on an emergency, basis.

The following courses, included among the permanent offerings, will be available during the present academic year:

Applied Mathematics I and II. One-term courses, given in succession
Mathematical Theory of Vibrations. First term only
Theory of Elasticity. Full-year course
Seminar on Vibrations. Second term only
Partial Differential Equations. Full-year course
Calculus of Variations. Full-year course
Seminars on Partial Differential Equations and Calculus of Variations, Advanced Ordinary Differential Equations. Second term only
Probability and Statistics. Full-year course

These regular graduate courses began September 23, 1941. Late registration is permissible for research workers in defense industries. Requests for bulletins containing details of these courses, as well as other inquiries, should be directed to the Graduate Center of Mathematics, New York University, 53 Washington Square South, New York, N. Y.

Plans are being completed by the College of Engineering to offer again several courses under the Engineering, Science, and Management Defense Training Program of the United States Office of Education. Unlike the regular courses, these courses will in general earn no college credit. No tuition fees will be charged. The courses are designed to meet particular needs of research workers in defense activities and will emphasize principally methods of solving concrete problems.

Tentative offerings for this term are given below.

Variational Methods for Solving Partial Differential Equations
Selected Problems in Vibrations
Selected Problems in Fluid Dynamics
Applications of Complex Variable Function Theory to Problems of Electrical Engineering

Supplementary courses of lectures or seminars on such topics as geometrical optics, dynamics of gases, ballistics, etc., are subject to later announcement.

Inquiries should be directed to the Defense Training Office, New York University, College of Engineering, University Heights, New York, N. Y.

Welding Society Awards Miller and Lincoln Medals

PRESENTATION of the 1941 Miller Memorial Award and the Lincoln Gold Medal for 1940-1941 was made at the annual meeting of the American Welding Society, Oct. 20, 1941, at Philadelphia, Pa.

The Samuel Wylie Miller Memorial Medal was awarded to David Arnott, vice-president and chief surveyor of the American Bureau of Shipping, New York, N. Y., and second vice-president of the American Welding Society, for conspicuous contributions to the art and science of welding.

Award of the Lincoln Gold Medal was made to Robert H. Aborn, member A.S.M.E. and member of the staff of the research laboratory, United States Steel Corporation, Kearny, N. J., for his paper, entitled "Metallurgical Changes at Welded Joints and the Weldability of Steels."

The award of the Miller Medal was made for conspicuous contributions to the art and science of welding during Mr. Arnott's long service with the American Bureau of Shipping which he joined in 1918.

Ford R. Lamb, A.S.T.E. Secretary, Dies

FORD R. LAMB, executive secretary, past-president, and charter member of the American Society of Tool Engineers, founded in 1932, died at his home in Pinckney, Mich., Oct. 26, 1941.

The American Railway Engineering Association Presents Tablet to University of Illinois

Citing the Work of Professor A. N. Talbot on Stresses in Railroad Track

A FEW months ago Prof. A. N. Talbot, Mem. A.S.M.E., resigned the chairmanship of the A.R.E.A. Committee on Stresses in Railroad Track. This committee started an investigation of stresses in railroad track in 1914, and the investigation is still in progress. Professor Talbot has been in charge of this investigation since its beginning. The reports of this investigation constitute the best body of information about stresses in railroad track available anywhere. The very first progress report was hailed as a classic in engineering research. It is as fine an example as can be found of an investigation in which mathematical analysis, laboratory tests, field tests, and the accumulated experience of practical engineers have been blended into a coherent whole.

In honor of Professor Talbot's leadership in this investigation the American Railway Engineering Association on October 21, 1941, unveiled a tablet citing Professor Talbot's achievements in this work, and presented the tablet to the University of Illinois to be placed in the Arthur Newell Talbot Laboratory of Materials Testing.

Preceding the formal unveiling of the tablet, a luncheon was given by the A.R.E.A. to invited guests at which Mr. Louis Yager, chairman of the special A.R.E.A. tablet committee, presided. The formal unveiling of the tablet took place in the College of Engineering of the University of Illinois at 4 o'clock in the afternoon. The ceremony was attended by a large number of students and members of the faculty, by some fifty members of the A.R.E.A., and other guests. Mr. W. S. Lacher, secretary of the A.R.E.A., was the presiding officer, Dean M. L. Enger accepted the tablet for the University, and Mr. F. L. C. Bond, president of the A.R.E.A. and vice-president and general manager of the Canadian National Railways, delivered the principal address. The response by Professor Talbot closed the exercises.

A. D. 1941
TO
ARTHUR NEWELL TALBOT
WITH AFFECTIONATE ADMIRATION
OF HIS FINE PERSONALITY
THE AMERICAN RAILWAY ENGINEERING ASSOCIATION
INSCRIBES THIS TABLET
IN
RECOGNITION OF HIS PREEMINENCE
IN ENGINEERING EDUCATION AND RESEARCH
WHEREIN HE HAS MADE NOTABLE CONTRIBUTIONS
TO THE SCIENCE OF ENGINEERING
AND IN
ACKNOWLEDGMENT OF HIS BRILLIANT RESEARCH
AS CHAIRMAN OF THE ASSOCIATION'S COMMITTEE
ON STRESSES IN RAILROAD TRACK
FROM 1914 TO 1941
WHEREBY WERE BROUGHT TO LIGHT
FACTS AND PRINCIPLES ON WHICH TO FOUND A RATIONAL BASIS
FOR THE DESIGN OF TRACK
OF GREAT VALUE TO RAILROAD TRANSPORTATION

This tablet is a well-deserved tribute to a great piece of engineering research and to Professor Talbot, the chief of the test party which carried out the work.

To Limit Number of Steel Specifications

INCREASED production of steel from existing facilities during the national emergency by concentration on a minimum number of steel specifications, compositions, sizes, and shapes is expected to result from a new project launched by the Office of Production Management.

At the request of O.P.M., three national organizations—the American Society for Testing Materials, Society of Automotive Engineers, and the American Iron and Steel Institute—will carry out the project with the collaboration of the War and Navy Departments, under the general supervision of O.P.M. An Administrative Committee to direct the work has been formed of representatives of these five bodies with advisers from other interested organizations, and is headed by C. L. Warwick, Consultant, Office of Production Management, and Secretary-Treasurer of the A.S.T.M.

The goal as defined by the Administrative Committee at its first meeting on September 12 is to establish as promptly as possible a selected list of steel specifications, to be designated National Emergency Steel Specifications, which in effect involves the selection of the minimum number of steel specifications, compositions, and sections necessary to meet the requirements of National Defense, both direct and indirect.

It is believed that the productive capacity of the steel industry, and of the manufacturing industries using steel for defense equipment, can be materially increased within present facilities by concentration of production upon a reduced number of steels, particularly with respect to alloy steels. Consideration will necessarily be given to nondefense requirements for steel in establishing the List of National Emergency Steel Specifications.

It is the intention of O.P.M., through its Iron and Steel Section, to use the list as an aid in administering both steel priorities and allocations.

The Administrative Committee indicated that the purpose is not to write new specifications, but primarily to select from existing specifications the practical minimum, in order to get the maximum production of planes, tanks, guns, ships, and all other defense equipment.

A classification of steel products has been made, and committees of technical representatives of both users and producers of steel are being organized to handle the work. The committees on carbon and alloy steel plates, and on aeronautic steels, will be the first to get under way. These committees will take full advantage of the extensive standardization which has already been accomplished in this field. In all of this work, the committees will keep constantly in mind the degree of scarcity of critical metals and alloying elements and the need for conserving them for the most effective utilization in the defense program.

N.C.S.B.E.E. Holds 22nd Annual Meeting in New York

THE twenty-second annual meeting of the National Council of State Boards of Engineering Examiners was held in New York, N. Y., Oct. 27–30, 1941, with headquarters at the Hotel Pennsylvania.

As announced previously in MECHANICAL ENGINEERING, decision to hold its convention in New York was based on an invitation of the A.S.M.E. and other Founder Societies. The 1941 convention immediately preceded the annual meeting of E.C.P.D. and served to bring these two groups into closer relationship.

Members of the Founder Societies and E.C.P.D. were invited to attend the N.C.S.B.E.E. annual dinner on Tuesday, October 28, at which the A.S.M.E. was represented by Francis Hodgkinson. Presiding at the dinner was Ole Singstad, chief engineer, New York City Tunnel Authority, and president, American Institute of Consulting Engineers. Roy V. Wright, past-president A.S.M.E., represented this Society on the General Committee for the Annual Meeting.

The dinner was addressed by the Honorable Fiorello La Guardia, Mayor of the City of New York, and United States Director of Civilian Defense, who took a few moments out of his campaign for re-election to welcome the engineers. Greetings to the honor guests were extended by Virgil M. Palmer, member A.S.M.E.,

NEW N.C.S.B.E.E. OFFICERS

(C. C. Knipmeyer, professor of electrical engineering, Rose Polytechnic Institute (right), new president of the National Council of State Boards of Engineering examiners, and (left) T. Keith Legaré, executive secretary of the council.)

president N.C.S.B.E.E., and C. C. Kirby, past-president, the Dominion Council of Professional Engineers, secretary and registrar, Association of Professional Engineers of the Province of New Brunswick, responded.

A luncheon was held at the Engineers' Club, New York, on Wednesday noon, at which representatives of the Founder Societies were also present. On Thursday members of the N.C.S.B.E.E. were invited to attend the annual meeting and dinner of E.C.P.D.

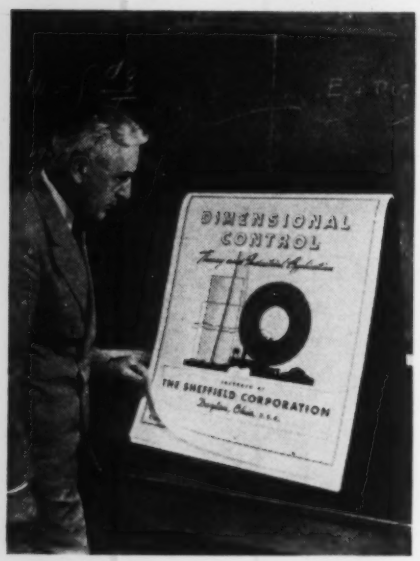
Prof. C. C. Knipmeyer, Rose Polytechnic Institute, Terre Haute, Ind., was elected president for 1941-1942, and T. Keith Legaré, of Columbia, S. C., was re-elected secretary.

Charts on Dimensional Control Available for Defense Classes

THE Sheffield Corporation of Dayton, Ohio, has prepared a portfolio of 40 educational gage charts for use in college, university, vocational, and defense-training classrooms. Accompanying the portfolio is a detailed lecture on industrial gaging.

The charts, titled, "Dimensional Control, Theory and Industrial Application," are written for the student and give an over-all picture of precision gaging in modern industry.

A limited number of these charts are being distributed to educational institutions. The charts give numerous basic definitions covering such topics as dimension, tolerance, limits, clearance, interference. They also have illustrations of different types of gages; an explanation of unilateral and bilateral tolerances; tables of fits and tolerances; micrometer readings of thickness, showing chance variation in reading; various application of gages; and an explanation of selective assembly and interchangeability.



PROF. C. A. JOERGER, HEAD OF MECHANICAL ENGINEERING DEPARTMENT, UNIVERSITY OF CINCINNATI, EXAMINING ONE OF THE CHARTS ON DIMENSIONAL CONTROL

Among the Local Sections

Anthracite-Lehigh Valley Members Attend Conference

MEMBERS of Anthracite-Lehigh Valley Section attended the conference of the A.S.M.E. and A.I.M.E. coal and fuels divisions on Oct. 31 at Easton, Pa. Speaker was E. G. Bailey, vice-president, Babcock & Wilcox Co., who discussed "The Better Utilization of Coal."

Baltimore Section Holds Session on New Plastics

"Modern Plastics" was the title of the talk presented by Alfred Egerter at the Oct. 27 meeting of the Baltimore Section. He covered the many new types of plastics in use today, their fundamental characteristics, and methods of manufacture and applications.

National Defense Stressed at Birmingham Meetings

To acquaint its members with the problems encountered under the National Defense program, Birmingham Section is devoting its monthly meetings to pertinent subjects. At the Sept. 26 session, Aubrey H. White, Stockham Pipe Fittings Co., showed how his company was able to undertake the manufacture of shells. The Oct. 30 meeting was devoted to a discussion of the "Effect of Priorities in Small Industries" by Paul Wright. He considered the difficulties met in the procurement of material for defense as well as nondefense industries and the effects of the present tendency toward growth and expansion of small industries due to defense orders.

Special Type of Inspection Method Described to Central Indiana

At the Oct. 10 session of the Central Indiana Section, John Thomas, Magnaflux Corporation, gave an illustrated talk on the development of the Magnaflux method of inspecting for hidden flaws and how it is used today on all types and shapes of materials.

Central Pennsylvania Holds National Defense Session

Colonel Crosby Field, Ordnance Department Reserves, as guest speaker at the Oct. 30 meeting of the Central Pennsylvania Section, gave a paper on "The Engineer Looks at National Defense." According to him, the engineer is expected to have a position of increasing importance in modern warfare, which today is on the offensive as contrasted to the defensive type employed in the immediate past. The unusual nature of the present war has upset preparations thought to be sufficiently complete.

Chicago Reports on Activities for September and October

C. C. Austin, chairman of the Chicago Section, has reported the following noteworthy activities of the Section for the months of September and October. The annual smoker held on Sept. 26 drew an attendance of 250. This was purely a social gathering with no technical subjects discussed. The Junior Group held its first technical session on Oct. 14 and had an attendance of 50. J. O. Lang, patent engineer with the Crane Company, talked on "High Lights on Patents, Trademarks, and Copyrights." The Chicago subway was inspected on Oct. 24 by a group numbering approximately 300.

Cleveland Hears Talk on War, Priorities, and Materials

The October meeting of the Cleveland Section held on the ninth featured as guest speaker George F. Nordenholt, member A.S.M.E., and editor of *Product Engineering*, who talked on the subject of "War, Priorities, and Substitute Materials." He showed how engineers can use substitute materials for those which cannot be obtained because of the war and priorities. The attendance was more than 150 at this combined meeting with the Machine Design Division of the Cleveland Engineering Society.

Columbus Section Members Go Through Oilcloth Factory

On Oct. 24, about 40 members and guests of the Columbus Section made an inspection trip through the plant of the Columbus Coated Fabric Company and saw the manufacture of oilcloth, artificial leather, and other coated materials.

Machine Tools and Priorities Subject of Detroit Meeting

Howard W. Dunbar, technical chief of the machine-tool division of the Office of Production Management, was the speaker at the Oct. 7 meeting of the Detroit Section. More than 125 members and guests heard the speaker tell of the need for industry to realize the seriousness of the present situation and, although a splendid job has already been done, that national defense is the paramount issue today and that all else must give way to it. Mr. Dunbar spoke of the tremendous increase in capacity for production being imposed upon the machine-tool industry and of the necessity

of government, management, and labor to join together to win this battle of equipment and production.

Our First Line of Defense Is Topic at East Tennessee

Ford L. Wilkinson, Jr., was the guest speaker at the Oct. 24 meeting of the East Tennessee Section in Knoxville, Tenn. His subject was "Our First Line of Defense," which according to him is in the industries of America.

Fort Wayne Told City-Operated Power Plant Is Successful

Wayne Kehoe, guest speaker at the Oct. 9 meeting of the Fort Wayne Section outlined the problems of operating a successful city-operated power plant. One of the problems was the employee relations as compared to a privately owned plant. The speaker also described some of the new equipment in the local city-owned plant and discussed some combustion problems encountered in the new boilers.

Milling Process Analyzed for Hartford Section Members

More than 250 members and guests of Hartford Section were on hand on the evening of Oct. 7 to hear Mario Martellotti give his paper, "An Analysis of the Milling Process." The paper presented a precise analysis of the motion of milling cutting teeth relative to the work, the elimination of backlash, and a comparison with up and down milling.

Machine-Tool Industry Meets Emergency, Ithaca Section Told

Tell Berna, at the Oct. 24 session of the Ithaca Section, told of the wholehearted cooperation of the machine-tool builders in defense work and the absence of labor trouble in that field. He pointed out many of the difficulties which had to be met and the necessity of having good tools in the defense industries.

Kansas City Section Has Papers on Bombs and Refractories

The Sept. 19 meeting of Kansas City Section featured C. E. Smith, Mexico Refractory Company, who spoke on "The Manufacture and Uses of Refractories." At the Oct. 17 session, L. D. McDonald spoke on the construction of the Fairfax Bomber Plant located in Kansas City, Kansas.

More Than 100 Los Angeles Engineers Greet President Wm. A. Hanley

Los Angeles Section held a dinner and meeting on Oct. 21 in honor of William A. Hanley, president of the Society. More than 100 engineers heard his interesting talk on "National Defense—Today and Tomorrow." Master of ceremonies for the evening was Prof. R. L. Daugherty, past vice-president A.S.M.E. Among the distinguished guests who greeted President Hanley was Robert A. Millikan, president of the California Institute of Technology.

October Meeting of Minnesota Section Devoted to Business

Minnesota Section held a dinner meeting on Oct. 27. Chairman M. S. Wunderlich announced the appointment of student-prize fund, program, and membership committees. The meeting concluded with the showing of Vernon Smith's colored motion pictures, "Big Game Hunting in the Canadian Rockies," and "Wild Fowl Shooting."

Newsletter Sent to Members of Nebraska Section

Following a meeting of the executive committee of Nebraska Section on Sept. 13, a newsletter was sent to members of the Section together with a membership list. Arrangements were also made to participate in the fall meeting of the Nebraska Engineering Society on Oct. 25.

Ladies Are Invited to October Session of New Haven Section

"Home Defense" was the title of the talk presented on Oct. 21 by Maxwell C. Maxwell, The Yale & Towne Mfg. Co., before the New Haven Section. The lecture was illustrated with motion pictures and large moving mechanical replicas of locks as used by the Egyptians, Romans, medieval Europeans, early Americans, and moderns.

Open Forum Features October Meeting of New Orleans Section

The Oct. 15 meeting of New Orleans Section featured an open forum followed by a motion picture on an engineering subject.

New Type of Pump Described to North Texas Section Members

P. E. Loye, vice-president of Reda Pump Co., told the members of the North Texas Section at the Oct. 30 meeting about the history of the Read pump and its application for underwater work. He illustrated his talk with slides and drawings which brought technical data on the design and operation of the pump.

Norwich Hears Paper on Jig and Fixture Design

At the Oct. 23 meeting of the Norwich Section in New London, Conn., Prof. Joseph W. Roe outlined the economics involved in the use of jigs and fixtures principally with regard to "borderline" cases where their use would be more or less limited. He then illustrated a number of useful points to be borne in mind when designing for jigs and fixtures. An interesting discussion followed.

Ontario Learns About Precision Measuring Instruments

The use of stroboscopic instruments and sound-measuring meters was fully described by L. E. Packard, General Radio Co., to the members of Ontario Section at its Oct. 9 meeting. Slow-motion pictures were then shown about birds and insects in flight as well as the action of smoke passing through fan blades, etc.

Substitute Materials Discussed at Philadelphia

Strategic metals and their substitutes were listed and described by R. E. McConnell at the Oct. 28 meeting of the Philadelphia Section. He presented facts and figures showing what this country's shortages are in various ferrous and nonferrous products, and why they occur. N. L. Mochel in discussing the paper cited instances to show what the Westinghouse Elec. & Mfg. Co. had done to overcome certain shortages. G. A. Ebelhare blasted claims in recent press articles that we would soon be building automobiles of plastics to the exclusion of steel by stating that a shortage of phenol, formaldehyde, and other chemicals prevents such a solution.

Igor I. Sikorsky Guest Speaker at Providence

More than 300 members and guests attended the Oct. 7 meeting of the Providence Section to meet and hear Dr. Igor I. Sikorsky, famous aeronautical engineer, talk on "Recent Developments in the Helicopter." He explained the construction of the helicopter and its possibilities, accompanying his talk with technicolor movies showing tests made with this type of machine.

Army Maneuvers in South Described to Raleigh Members

On Oct. 16, Col. J. H. Harrelson outlined briefly to members of Raleigh Section the preparation necessary for assembly and the movement of troops gathered in the south for the largest peacetime maneuvers ever held in this country. Preparation included procurement and plans for handling enormous quantities of food and for obtaining civilian permission for use of private lands for the maneuvers. Plans also had to be made for the continuance of normal civilian life within the maneuver area.

Quality Control in Industry at Joint Rochester Meeting

At a joint meeting of the Rochester Section and the Rochester Engineering Society on Oct.

16, Walter A. Shewhart, research statistician of the Bell Telephone Laboratories, presented an illustrated paper before 161 engineers on "Quality Control in Industry." He described statistical methods in engineering which have been applied successfully for control of quality in manufactured products.

Service Schools of the Navy Described at Rock River Valley

Commander C. E. Olsen, U.S.N., officer in charge of the Navy Service Schools, Great Lakes Training Station, was the guest speaker at the Oct. 23 meeting of the Rock River Valley Section held in Rockford, Ill. He covered the methods of selection and training of enlisted Navy personnel by the thousands to fill machinist, fireman, radioman, and other vacancies. Films used in machine-shop courses were shown.

President William A. Hanley Guest of San Francisco at Dinner Meeting

William A. Hanley, president of The American Society of Mechanical Engineers, was the guest of honor at the Oct. 23 dinner meeting of the San Francisco Section. Taking as his topic, "National Defense—Today and Tomorrow," President Hanley among many things said, "Two great jobs confront the American people: To do their part in providing enough ships, guns, and planes for national defense, and second, to prepare for the aftermath of war by backlogging every project which isn't necessary for national defense. When I say backlogging all projects unnecessary to national defense, I mean such things as building homes and roads, attending to civic improvements. If we save this great mass of work for peacetime, we have a solution for the unemployment problem which must be faced then."

Susquehanna Section Holds Joint Meeting in York, Pa.

At a joint meeting with the Engineering Society of York on Sept. 29, Susquehanna Section had 25 A.S.M.E. members present as compared to 75 engineers from other groups. A series of high-speed films produced by Professor Edgerton was shown.

Utah Section Welcomes President of A.S.M.E.

Guest of honor at the Oct. 18 meeting of Utah Section was William A. Hanley, president of the Society, who gave his talk on "National Defense—Today and Tomorrow." A thought left with the members was that "Free enterprise, the right to work, thriftiness, and security are four essentials on which America must build its national structure after the present world conflict is ended."

A.S.M.E. Aims and Objectives Outlined by H. H. Snelling at Washington, D. C.

Henry H. Snelling, past vice-president A.S.M.E., was the guest speaker at the Oct. 9 meeting of the Washington, D. C., Section. More than 75 members and guests heard him outline the "Aims and Objectives of the A.S.M.E."

Mechanical Handling Devices Described at Waterbury

The Oct. 16 meeting of Waterbury Section featured a paper by Maxwell C. Maxwell on "Hundred-Horsepower Hands." He described with the assistance of drawings and photographs the evolution of hoists, cranes, trucks, and other mechanical handling devices.

Western Massachusetts Learns About Light Metals and Alloys

More than 60 members and guests attended the Oct. 21 dinner meeting of the Western Massachusetts Section. Dr. Norman E. Woldman, taking as his topic light metals and alloys, discussed particularly aluminum and magnesium, the two lightest metals known. Various alloys of these two metals were described, including their resistance to corrosion, heat-treatment, and ways of salvaging castings of these two metals which ordinarily would be rejected because of blowholes or porous sections.

Worcester Told Need of Fire Protection in National Defense

With 50 members and 100 guests present, Worcester Section at its meeting of Oct. 9 presented as speaker Arthur B. Guise, Rockwood Sprinkler Co., who discussed "Fire Protection Trends in Industry During an Emergency Period." He showed how with an acceleration in production, carelessness tends to increase thereby making it necessary to depend more on automatic means of fire and accident prevention.

The Worcester Section has recently tried an interesting experiment by sending out a check list to its members to have them indicate the type of paper or kind of meeting that would particularly interest them. An analysis of the membership list of the Section showed that 11 specialized in machine-tool manufacture, 15 in steam power, 13 in steel mills, 15 in design drafting, a dozen in teaching, and the remaining group in manufacturing of all sorts of products varying from leather goods to railway cars. The check list gave 18 specific topics, as well as space to write in additional ones. It asked for suggestions of speakers, plant-inspection trips, and industrial motion pictures. Through this list the Section hopes to have extremely worthwhile winter meetings.

Junior Group Activities

Priorities and the Effect on Business Subject Before Philadelphia Juniors

A TIMELY talk on priorities by John Leonard, assistant director of the third district O.P.M., was well received at the October meeting of the Philadelphia Junior Group. Specific problems drawn from the work of the members brought out clearly the need for a clearer understanding by all concerned of priorities and their effect on business.

The problems of marine-power equipment, which carry high priority ratings, will be presented at the next meeting scheduled for Nov. 20. The Group is looking forward to a very active year in which many more problems of immediate interest will be brought to the attention ot Juniors through the meetings and inspection trips.

Los Angeles Juniors Make Trip Through American Can Co. Manufacturing Plant

APPROXIMATELY 30 members and 30 guests of the Los Angeles Junior Group took part in the inspection trip made on Oct. 2 to the Los Angeles plant of the American Can Company. An interesting evening was spent inspecting the processes and automatic machinery connected with the manufacture of fiber milk containers and "packers tin cans," including the coating and lithographing operations involved.

Metropolitan Juniors Hear Airplane-Propeller Talk

AT its first meeting of the 1941-1942 season, held in the Society's rooms, on October 28, the Junior Group of the Metropolitan Section of The American Society of Mechanical Engineers presented J. I. Hamilton, administrative engineer, and J. H. Sheets, project engineer, both of Curtiss-Wright Corporation, Propeller Division. The topic of the meeting was "Airplane Propellers—Their Design and Construction."

Mr. Sheets first outlined the developments in this field since the original solid constant pitch propeller, and the reasons for this development. He then discussed the many forces which influence the design of the pitch-changing mechanism and the hollow steel or aluminum-alloy constant-speed electric propeller. He also explained the construction

and operation of the mechanism as made by Curtiss-Wright.

Mr. Hamilton explained the electrical control of the pitch-changing mechanism to obtain constant motor speed, the control being actuated by a governor. He also discussed the use of the pitch-changing controls to automatically keep the motors of a multi-motored ship synchronized. Both speakers showed well-chosen slides to illustrate their talks.

The meeting had been preceded by an informal dinner in a near-by restaurant and after an interesting discussion, the meeting was adjourned.

A.S.M.E. Local Sections

Coming Meetings

Anthracite-Lehigh Valley: January 23. Allentown, Pa., at 8:15 p.m. Subject: "Survey of National Defense Work by Colleges and Industries," by Paul B. Eaton, head of mechanical-engineering department, Lafayette College, Easton, Pa., and F. V. Larkin, mechanical-engineering department, Lehigh University, Bethlehem, Pa.

Central Indiana: December 12. Indianapolis Athletic Club at 6:30 p.m. Subject: "Photoelasticity," by O. J. Horger, in charge of railway engineering and research, Timken Roller Bearing Company.

Cleveland: December 11. Cleveland Engineering Society at 8:00 p.m. Subject: "The Kind of a Peace We Are Fighting for," by William E. Wickenden, president, Case School of Applied Science, Cleveland, Ohio.

Fort Wayne: December 11. Indiana Hotel (Old Fort Room) at 6:30 p.m. "Plastics in Structural Design for Aircraft," by R. L. Davis, sales engineer, General Electric Co.

Nebraska: December 11. University of Omaha Auditorium at 8:00 p.m. Two films will be shown—"Neoprene" and "The Magic of Modern Plastics." These films are available through the courtesy of E. I. du Pont de Nemours Company.

Norwich: December 16. New London Junior College at 8:00 p.m. Subject: "National Defense in the Air," by R. F. Powers, division sales manager of Colonial Beacon Oil Company.

Philadelphia: December 9. Franklin Institute Auditorium, 20th St. & Parkway, Philadelphia at 7:45 p.m. Subject: "The Inside Story of Development and Manufacture of Medium Tanks M-3," by Lieut. H. J. Seiler, chief of industrial service, Philadelphia Ordnance District, Philadelphia; and Lieut. R. C. Disney, in charge of Eddystone Sub-office, Philadelphia Ordnance District.

Providence: December 2. Engineering Society Rooms, 195 Angell St., Providence, R. I. at 8:00 p.m. Subject: "World's Largest Plate Mill," by W. G. Theisinger, Lukens Steel Co., Coatesville, Pa., director of welding research.

St. Joseph Valley: December 16. Joint Meeting with American Institute of Electrical Engineers and Indiana Power Engineers. This will be the big event of the year in technical importance.

With the Student Branches

Membership in A.S.M.E. for Students of Purdue University Advocated by Paper

Editorial in *Purdue Exponent* Outlines Advantages Enjoyed by Student Members Now and in the Future

EDITORIALLY, the *Purdue Exponent* in its Sept. 24 issue warns students about joining any of the many organizations which are found on every college campus. However, the editorial states, there is one group of organizations that is well worth considering. It is the professional engineering societies on the campus, The American Society of Mechanical Engineers, and others. These student organizations are integral parts of the national societies, whose membership includes the outstanding engineers in the country.

Membership in a professional society, continues the editorial, offers an excellent opportunity for intimate contact with the engineering profession. Engineering students should want to take part in engineering activities, know other engineers and their work, and participate in the promotion of their profession. All of these are possible through membership in such an organization. One of the big advantages of joining an engineering society now is that most of them allow student members to acquire national membership without the payment of an initiation fee. Other benefits to be derived are subscriptions to the society magazine and other publications, use of engineering libraries, participation in research projects, and use of employment services for summer positions and jobs after graduation.

In conclusion the editorial states that it is even more important today that engineering students associate themselves with their society, since engineers are keymen in national defense. Here is an opportunity for students to identify themselves as members of a profession that is extremely important to our country.

Hypnotics at Alabama Poly

HYPNOTISM was the subject of the lecture and demonstration given by Prof. C. R. Hixon at the Sept. 30 meeting of ALABAMA POLY BRANCH. Whether they were under the influence of the professor or not, quite a number of new members hurried to pay up their dues at the end of the session.

ARIZONA BRANCH at its Oct. 8 meeting featured a talk by student member Jack Lyons about his experiences during the summer while working for a submarine construction company in New London, Conn. On Oct. 22, the speaker was Prof. J. L. Jones, his subject being a description of sales engineering.

ARKANSAS BRANCH held two meetings within the space of three days. On Sept. 26, Prof. R. G. Paddock outlined the activities of the Branch and the advantages of membership. At the Sept. 29 meeting, the guest speaker was Prof. H. E. Degler, University of Texas, who also stressed A.S.M.E. membership for students.

AERIAL VIEW OF THE EIGHT INSTRUCTIONAL BUILDINGS AND THE POWER PLANT OF THE MICHIGAN COLLEGE OF MINING AND TECHNOLOGY

THIRTY-SEVEN MEMBERS OF DUKE BRANCH ATTENDED AN INSPECTION TRIP TO WEIRTON STEEL COMPANIES PLANT IN WEIRTON, WEST VA., ON OCTOBER 24

(Ernest Theiss, extreme right in picture, was the faculty member in charge of the trip.)

Student members of BRITISH COLUMBIA BRANCH at the Oct. 9 meeting decided that at each meeting of the Branch two members will each give a 15-minute talk, except when an outside speaker or feature is obtained. Speakers will be given two weeks in which to prepare papers. John Tarbox started the program going with a 15-minute talk on the equipment layout of the new plant of Boeing Aircraft Co. on Sea Island.

President Hanley Guest of California

William A. Hanley, president of The American Society of Mechanical Engineers, was the guest of honor and speaker at the Oct. 23 meeting of the CALIFORNIA BRANCH. His talk on "National Defense, Today and Tomorrow," proved to be both interesting and enlightening to all the members present as he told about the part played by engineers in the defense effort of the present and the future.

C.C.N.Y. BRANCH turned over its meeting of Oct. 23 to R. De Vere Hope, consulting engineer, who spoke on "New Frontiers in Engineering." He maintained that continual advancement is necessary for successful business management. This advancement was divided into two classes by him, expansion of present fields and development of new products and methods. He pointed out the relative ease in the establishment of new ideas and products compared with the difficulty in maintaining standard products and methods.

COLORADO BRANCH's first meeting of the 1941-1942 term was held on Oct. 8 and attended by more than 75 members and guests. After the chairman of the Branch, Carl J. Perko, explained the objects and aims of the organization, Walter Shaw gave a very interesting account of his summer employment with Pratt & Whitney in Hartford, Conn.

Colorado State Holds Trips

As part of its program for the coming semester, COLORADO STATE BRANCH has held and will hold inspection trips besides its regular meetings at which outstanding engineers are scheduled as speakers. Inspection trips held included one to Boulder Dam on Oct. 18, an inspection of a sugar factory in Fort Collins on Oct. 24, and a visit to the Bureau of Reclamation Laboratory in Denver, Colo., on Nov. 1. With such interesting trips and sessions, it will not be very long before the membership committee attains its goal of 50 members.

COOPER UNION BRANCH (day) devoted its entire meeting of Oct. 15 to business. After making changes in the constitution of the organization, Murray Sackson, chairman, appointed members to the program, dinner, publicity, and gavel committees. Finally, plans were made for the presentation of student papers at future meetings.

200 at Cornell Meeting

Never has CORNELL BRANCH had as large a meeting as the one on Oct. 7 which was attended by more than 200 members and guests, who sat, stood, and squatted on the floor in order to view the motion picture of the *Airacobra* shown through the courtesy of the Bell Aircraft Co. of Buffalo, N. Y. The film showed the construction and operation of this latest type of warplane which carries a 37-mm cannon mounted in the hub of the propeller, two .50-caliber and four .30-caliber guns. It was also announced that after three years of untiring service as honorary chairman of the Branch, Prof. Paul H. Black, department of machine design, was retiring because of other work. Prof. L. T. Wright, department of heat-power engineering, was chosen as his successor.

DUKE BRANCH discussed plans at the Oct. 15 meeting concerning greater publicity and prestige for the organization. A committee was appointed by Chairman John G. Galt to accomplish these plans. On Oct. 24 the members visited the plant of the Weirton Steel Companies and later that day the Heinz plant in Pittsburgh, Pa. Saturday, the boys attended the Duke-Pitt football game.

FLORIDA BRANCH at its meetings during October encouraged the presentation of student papers and awarded cash prizes to the best ones at the Oct. 27 meeting. Speakers included Cooke, Morley, Snyder, Schoch, Bower, Holtsinger, Hughes, Lang, Shoemaker, Singer, and Wright. First prize of $4 went to Lang for his paper on "Design and Manufacture of Large-Caliber Guns." Second, third, and fourth prizes went to Cooke, Wright, and Hughes, respectively.

GEORGE WASHINGTON BRANCH held a successful opening meeting on Oct. 8 with more than 60 members and guests present. Dr. G. M. Kline, Bureau of Standards, gave a talk on plastics, covering the physical and chemical properties of each type, and discussing their present and future applications. L. A. Wood, another Bureau member, discussed rubber and its properties.

IDAHO BRANCH members numbering 25 attended the Oct. 15 session which was devoted to a discussion of business. It was decided to hold meetings twice a month, the second and fourth Wednesdays.

IOWA BRANCH presented at its Oct. 22 meeting a paper on meteors by John Young. The paper covered their history, source, behavior, and composition.

Iowa State Peace Pipe

At the first meeting of IOWA STATE BRANCH on Oct. 1, Professor Breckenridge in accordance with an old custom passed a "peace pipe" around for the more than 100 students to smoke while he related the more interesting events in the history of the Branch. The pipe was constructed of parts salvaged from an airplane which crashed last year. Prof. M. F. Cleghorn then described the new equipment recently installed in the mechanical-engineering laboratory. After adjournment refreshments were served.

JOHNS HOPKINS BRANCH has elected Prof. Julian C. Smallwood as its new honorary chairman.

KANSAS BRANCH met on Oct. 16 with 65 members and guests present. Professor Brush, head of the aeronautical-engineering department, discussed the production of sheet-metal parts for airplanes, the various metals used, and the tools used in forming these metals into fuselage and wing sections.

Kentucky Welcomes Alumnus

There were 83 members of KENTUCKY BRANCH present on Oct. 3 to welcome J. Irvine Lyle, Kentucky alumnus and president of the Carrier Air Conditioning Corporation, who spoke on the subject, "The Young Engineer." He advised all engineers to start at the bottom in a field they liked, not to worry about big salaries, and eventually they would succeed.

LOUISVILLE BRANCH had practically all its

members present at the Oct. 9 meeting to welcome a representative of the parent Society, Ernest Hartford, assistant secretary. He gave an instructive talk in which he outlined the meaning, scope, and purpose of the A.S.M.E., and showed how a student branch is an integral part of the Society.

MICHIGAN BRANCH held a joint meeting with the school chapter of the S.A.E. on Oct. 23. After a dinner given for the officers of both groups and the speaker, the meeting was started with the motion-picture film, "Wright Builds for Air Supremacy," which gave a vivid description of the mass-production methods utilized in producing airplane power plants. This was followed with the introduction of the guest speaker, Clyde Paton, chief engineer of the Packard Motor Car Company, who described the work being carried on by his company for National Defense.

MICHIGAN COLLEGE OF MINES BRANCH opened the semester with the annual smoker, which this year was held on Oct. 6. The program consisted of a talk by R. R. Seeber on the subject, "Mechanical Development in Germany," based on observations made on his trips to that country in 1932 and 1936. Prof. A. P. Young, honorary chairman, and other members of the faculty were introduced at the close of the talk.

MICHIGAN STATE COLLEGE BRANCH held its opening meeting on Oct. 16 at which Prof. L. N. Field, honorary chairman, and other faculty members were introduced. On Oct. 29, a special meeting was called to commemorate the memory of Professor Field, who passed away Oct. 24, and to select a successor. Mr. J. M. Campbell was chosen.

MISSISSIPPI STATE BRANCH opened its 1941-1942 season under a cloud of cigar smoke on Oct. 9. The students were welcomed by chairman R. T. Staton, who outlined the year's program. In addresses by Prof. A. G. Holmes and Prof. H. P. Neal, special stress was laid upon the importance of and vital benefits derived from active student participation in local A.S.M.E. work.

MONTANA STATE BRANCH had a meeting on Oct. 23 at which papers were given by student members. Robert Johnston discussed "Power Bull Rakes," and Robert Anspach talked on "Analyzed Time."

Successful Nebraska Membership Drive

At the Oct. 22 meeting of NEBRASKA BRANCH, the chairman of the membership committee reported that 61 members have signed up so far. Prof. J. W. Haney showed some motion pictures which he took on a recent trip to Mexico.

NEWARK BRANCH at its Oct. 6 meeting had 75 members and guests present. Herbert D. Hall, president of the Hall Foundation, talked on "Dies and Diemaking." With motion pictures, he showed how diemakers can be trained rapidly to meet National Defense requirements.

N.Y.U. BRANCH (aeronautic). Charles Kroupa was the speaker at the Oct. 15 meeting. His talk dealt mainly with his experiences at the Grumman Aircraft Co. plant on Long Island. On Oct. 29, a senior gave a paper on the design problems of pressure airships.

N.Y.U. BRANCH (evening) got together on Oct. 1 for a business meeting at which committee chairmen were appointed, MECHANICAL ENGINEERING distributed, and the honorary chairman, Professor Church, introduced.

North Carolina Members Cook

Following a talk by Col. J. W. Harrelson, dean of administration, on "War Maneuvers in the Carolinas," at the Oct. 16 meeting of NORTH CAROLINA STATE BRANCH, the members and guests were conducted through the mechanical-engineering laboratories of the school. The tour ended in the forge shop where temporary grills were set up in the forges. With the blowers going full blast and the coals red hot, hamburgers and coffee were prepared by student members who acted as chefs.

NORTHEASTERN BRANCH has adopted the policy of having the members themselves give papers in preference to inviting guest speakers. So at the Oct. 9 meeting, Walter Skoglund gave a very interesting talk on "Radiography as Used in Shipbuilding." He was a qualified speaker on this subject since he is employed by the Bethlehem Steel Corporation at its Fore River, Mass., plant as a radiographer under the school's cooperative system.

NOTRE DAME BRANCH sponsored a dance after the Indiana-Notre Dame football game. Plans are now being made for an inspection trip to Chicago, Ill., and Beloit, Wis.

OHIO STATE BRANCH met on Oct. 17 and after dealing with business details, heard two papers. The first by Scarberry described his summer work with the Seagrave Corporation and the second by Lynch told about his job with the Allison Division of General Motors.

Professor Degler at Oklahoma

As a representative of the A.S.M.E. Standing Committee on Relations With Colleges, Prof. H. E. Degler visited OKLAHOMA BRANCH on Oct. 2. He gave an interesting speech and made several helpful suggestions about the internal and external affairs of the Branch.

OREGON STATE BRANCH's meeting of Oct. 9 was held as a get-acquainted session. In line with this thought, talks on their summer jobs were given by four of the student members. These included Charles Schumann, Franklin Yoakum, Ben Kirby, and Don Drake.

PENNSYLVANIA STATE BRANCH at its session of Oct. 20 presented a motion picture on the manufacture of Wright aircraft engines. R. S. Cole, Wright Aeronautical Corporation, spoke on the training methods for new employees.

PITTSBURGH BRANCH had a capacity audience of 270 at its Oct. 23 meeting. Feature of the session was a motion picture, "From Sun to Sun," which showed how electric power is generated and distributed.

PRATT BRANCH devoted its meeting of Oct. 14 to a discussion of plans for the coming semester. At the same time various committees were formed.

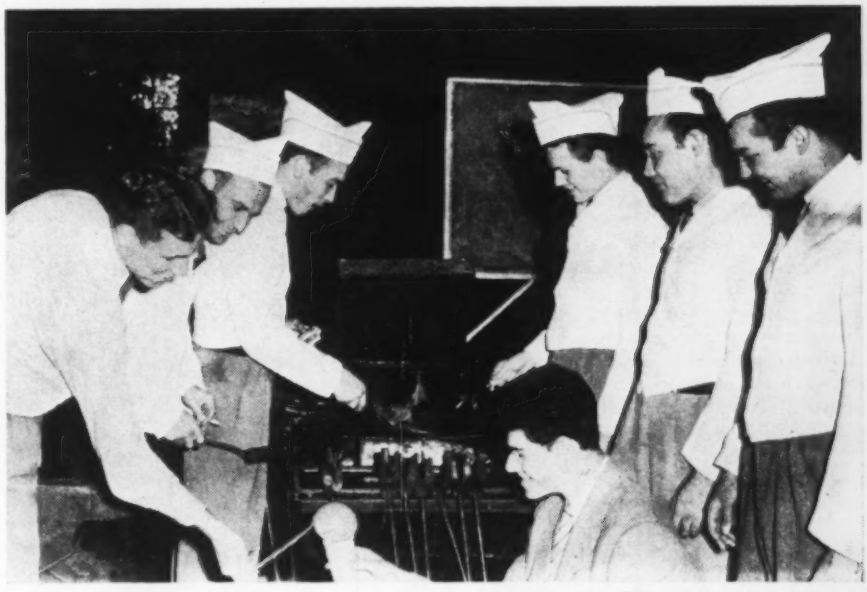
PRINCETON BRANCH opened the semester with a meeting on Oct. 14. Chairman Stewart Pach briefly summarized membership rules and Dean Kenneth H. Condit outlined the structure and function of the A.S.M.E.

PURDUE BRANCH held a meeting on Oct. 22 which had as speaker, Loran D. Gayton, assistant city engineer of Chicago, who described the construction of the South Chicago Filtration Plant, the largest in the world. The talk was accompanied by slides and colored motion pictures.

100 Per Cent Membership at Rose Poly

The first meeting of ROSE POLY BRANCH on Sept. 29 featured a talk on the advantages of membership in the Branch by Chairman Arthur D. Owens. The talk was a most convincing one because at the close of the meeting, all students eligible for membership joined.

RUTGERS BRANCH members and guests numbering more than 200 attended the Oct. 23 meeting which was highlighted by two sound motion pictures. The first was "Steel—Man's Servant," produced by the U. S Steel Corporation, and the second was "Wright



STUDENT CHEFS AT NORTH CAROLINA STATE COLLEGE PARTY

(*Left to right:* I. H. Hetherington, Jr., N. K. Lee, Jr., E. T. Light, R. B. Stevens, Jr., E. D. Hawkins, G. P. McKay, and I. L. Linten, seated.)

Builds for Air Supremacy," a production of the Wright Aeronautical Corporation. Refreshments of cider and doughnuts were served at the conclusion of the meeting.

SANTA CLARA BRANCH showed the film, "Steel—Man's Servant," at its Oct. 22 meeting which was held jointly with the local chapter of the A.I.E.E. Present were 25 A.S.M.E. and 30 A.I.E.E. student members.

U.S.C. Welcomes President Hanley

More than 40 student members of the UNIVERSITY OF SOUTHERN CALIFORNIA BRANCH welcomed William A. Hanley, president of the A.S.M.E., to the meeting of Oct. 21. Entitled, "Future Life Problems of the Engineer Attending School Today," the talk covered such problems as aviation, smoke elimination, and new forms of energy.

SOUTH DAKOTA STATE BRANCH made an inspection trip on Oct. 23 to the Brookings City power plant. The plant layout was described by its chief engineer. Besides supplying electric power, the plant is also used as a source of steam for the city heating system.

TENNESSEE BRANCH members assembled on the evening of Oct. 16 for the regular semimonthly meeting of the Branch. Some business was transacted, including the nomination of a girl to represent the A.S.M.E. in the Engineering Queen Contest.

TEXAS BRANCH believes in having student members present papers at Branch meetings. At the Oct. 6 session, papers on their summer work were given by C. E. Osborne, George R. Yelderman, Howell L. Walker, Karl F. Bartels, and Hub Colley. On Oct. 13, Luis H. Bartlett, testing engineer of the bureau of engineering research at the University, discussed "The History and Development of Quick-Freezing Processes." After adjournment of the meeting, he passed out samples of foods processed by the method being used in his present research work.

TEXAS TECH BRANCH tried something unusual at its meeting of Oct. 20. John B. McEwan, a student member, read a paper written by L. E. Peyton, Packard Motor Car Company, on the subject of "The Kind of Engineers Needed by the Automobile Industry." This paper was presented by Mr. Peyton at the 49th annual meeting of S.P.E.E.

TEXAS A.&M. BRANCH's program for the meeting of Oct. 23 was so interesting that 170 members and guests attended. The speakers were student members. Jack Smithers discussed the engineering and design features of the new 1942 automobiles, Bob Bruce spoke next on the superfinishing of engine parts, Joseph Gibbs gave some new ideas on the computation of demolition charges as used in military engineering, and George Nassauer told of his experiences as a testing engineer with Pratt & Whitney during the summer.

TUFTS BRANCH featured as speaker at its Oct. 30 meeting, L. C. Linn, chief of turbine design at the Lynn plant of the General Electric Co. He reviewed present-future turbine developments and also provided a lively discussion on the philosophy of engineering.

Navy Day at Tulane

Navy Day was celebrated on Oct. 23 by the TULANE BRANCH with a talk by Commander Brittain, U.S.N., head of the Tulane Naval R.O.T.C., on "Prime Movers in the Navy." The paper dealt specifically with turbines and boilers in all classes of surface vessels, statistics were given on the size, number, and arrangement of the turbines, and problems of design and operation. Plans were made to have all engineering students attend the Tulane-Alabama football game in "boiler suits."

VILLANOVA BRANCH's meeting of Oct. 3 attracted 132 members and guests. Guest speaker was Maxwell C. Maxwell, who gave an illustrated lecture on "Home Defense," which traced the history of locks from ancient times to the present day.

V.P.I. BRANCH requires every member to present during the year at least a short paper on some technical subject. The first four were given on Oct. 23 by John Martin, Ernest Christ, R. G. Broun, and L. A. Garvin. In the evening, the fall social of the Branch took place and proved a great success. Events included dancing, games, and refreshments. At the Oct. 30 session, speakers were L. G. Chase, J. C. Hildebrand, J. D. Clark, and B. A. Higgs.

WORCESTER TECH BRANCH had a meeting on Oct. 31 which drew more than 100 members and guests. Raymond Tolman, junior A.S.M.E. and class of 1938, introduced Howard G. Freeman, junior A.S.M.E. and class of 1940, who gave a paper on the application of the new "water-fog" sprinkler systems to fight fires from inflammable liquids. His talk was followed by a color motion-picture film showing the use of "water-fog."

WYOMING BRANCH's first meeting of the semester was held on Sept. 30. At this meeting, Prof. C. Edward Anderson, head of the mechanical-engineering department, was chosen honorary chairman.

YALE BRANCH in accordance with its policy had papers presented by student members during October. Speakers included Van Voast, Wallace, Warner, Warwick, Young, Parella, Twigg-Smith, Tuttle, McCready, Thompson, Melcher, Mueller, MacWilliam, Mikulich, and Turner. However, the Oct. 28 meeting was addressed by C. E. Smith, vice-president of the New York, New Haven, and Hartford Railroad, who discussed the relation of the railroads to National Defense.

Responsibilities of A.S.M.E. Student Branch Honorary Chairman

NOW that activities for a new college year are taking shape, it is worth while to take some time to review the responsibilities of the A.S.M.E. toward the mechanical-engineering student. Necessarily, these responsibilities are shouldered by the honorary chairman of the student branch of the A.S.M.E., as he is more directly responsible for acquainting the student with the national Society than are other faculty members. For this reason this discussion pertains largely to honorary chairmen.

First of all the A.S.M.E. Student Branch has the primary function to assist in the preparation of mechanical-engineering students for a useful and productive life in their profession. This can be accomplished by: (1) Increasing the engineering knowledge of the individual student; (2) developing interest in the me-

(*A.S.M.E. News continued on page 942*)

THE HAMBURGERS ARE GOOD—AT NORTH CAROLINA STATE

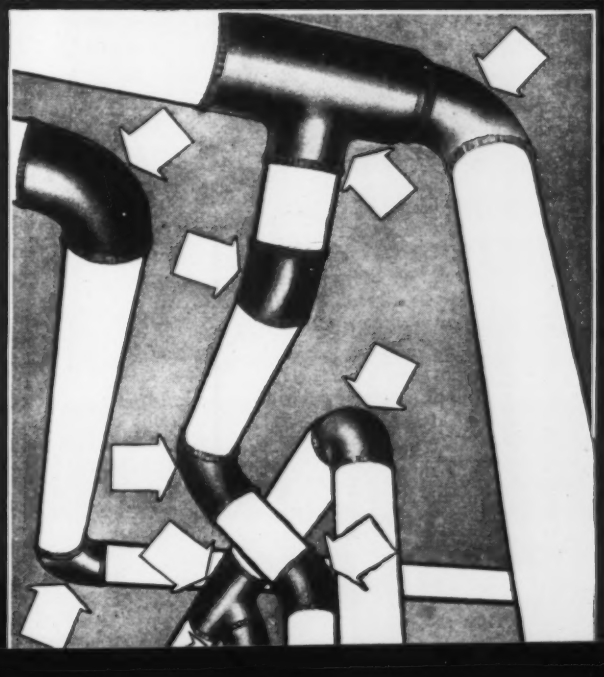
(*Left to right*, front row: Col. J. W. Harrelson, dean of administration, W. J. Andrews, oldest A.S.M.E. Member in State of North Carolina, Frank Turner, Chapel Hill, N. C., Prof. F. C. Bragg, honorary chairman of the Student Branch, Prof. L. L. Vaughan, head of mechanical-engineering department, Blake R. Van Leer, dean of Engineering School, North Carolina State, and E. T. Light, senior in mechanical engineering.)

Strain and speed are hardest to handle *at the turns* in PIPING, too!

On a bobsled run, constant danger lies at the banked turns. Here the utmost skill of the driver and braker are required to avert an accident. (*I.N.S. photo*).

WELDING WITH TUBE-TURNS REMOVES "DANGER AT THE TURNS" IN PIPING

When you think of "turns" in piping systems, remember they occur within tees, reducers, laterals, nipples, heads, etc., as well as within elbows and returns. Wherever there are abrupt *changes in flow direction* you'll find *extra* wear and tear. TUBE-TURN welding fittings provide maximum *extra* strength and safety, and practically eliminate maintenance troubles, at these *danger spots.*



nsure safer, stronger, trouble-free piping ystems with TUBE-TURN welding fittings

hen the fluids or gases in your piping systems zoom through the lines d swerve into the turns—*added* strain and friction strike the fittings d joints. Trouble usually develops here *first* in any piping system *ecause the most danger lies at the turns!*

eld with TUBE-TURN fittings and *your* plant piping systems will st far longer, function more efficiently and safely, save valuable space, d cut upkeep costs.

ere is a TUBE-TURN for *every change in flow direction*—elbows, turns, tees, reducers, laterals, nipples and flanges—made with Tube-urns' exclusive forging process to give unequalled reinforcement at ese danger spots.

Get complete facts in the helpful Tube-Turn engineering data book and catalog. Write today!

TUBE-TURNS, Inc., Louisville, Ky. *Branch offices:* New York, Philadelphia, Chicago, Pittsburgh, Cleveland, Tulsa, Los Angeles. *Distributors everywhere.*

TUBE-TURN

TRADE MARK

Welding ★The★ FIRST WELDING FITTINGS 1ST AND STILL THE BEST *Fittings*

chanical-engineering profession; (3) developing an understanding of the ideals to be attained in this profession; and (4) assisting the students in making the transition between school life and professional life.

Analyzing more closely these four means the honorary chairman can: (1) Increase engineering knowledge by careful selection of films and talks that will extend and broaden the student's appreciation of his textbook and class work; (2) develop interest in the profession by selection of programs designed to bring out fascinating features of mechanical engineering; (3) develop understanding of ideals by practice of those ideals in daily contacts with students and faculty members; and (4) assist in the transition to professional life by fostering contacts and acquaintances with men in industry and by promoting attendance at sectional, divisional, and national A.S.M.E. meetings.

The honorary chairman will find that in addition to guidance required for suitably carrying out the basic policies of the organization as mentioned, the officers will in many cases require guidance as to the actual performing of the purely mechanical details of their offices. These details include conducting business meetings according to the proper rules of procedure, keeping complete branch records, and keeping in touch with various committees and their efforts. By taking time to enlighten each officer as to the scope of his duties and by emphasizing the importance of keeping complete operating records, the honorary chairman can materially aid and expedite the activities of the branch.

It is the intent of the A.S.M.E. that the honorary chairman act as a guide for the student branch and refrain from assuming too great authority. The branch is a student organization and should be managed by the students. It is easy for the honorary chairman to overlook this point particularly in the matter of student papers entered in competition, but his interest in these papers should extend only to giving advice and encouragement.

Faculty members who have responsibility for the A.S.M.E. student branch have a great opportunity. Young men of these organizations are potential mechanical engineers and potential executives of the national A.S.M.E. In large measure their appreciation of the national A.S.M.E. and their ability to carry out duties successfully and to cooperate with their fellow engineers will be the result of their A.S.M.E. student activities. The future of the A.S.M.E. depends in large part on present and future student members whose success or failure is in some measure attributable to the influence of the honorary chairmen.

ROBERT G. CHAPMAN.[1]

[1] Assistant Professor of Mechanical Engineering, College of Engineering, Duke University, Durham, N. C.

Men and Positions Available

Send Inquiries to New York Office of Engineering Societies Personnel Service, Inc. This service is operated on a cooperative, nonprofit basis whereby those actually placed in positions by the Service agree to contribute to help maintain this service

29 W. 39th St. New York, N. Y. | 211 West Wacker Drive Chicago, Ill. | 57 Post Street San Francisco, Calif. | Hotel Statler Detroit, Mich.

MEN AVAILABLE[2]

PLANT MANAGER-SUPERINTENDENT with thorough experience in building, organization modern plant to delivery of finished product. Thorough mechanical and seasoned executive. Record and credentials high order. Me-708.

GRADUATE MECHANICAL ENGINEER, 44, assistant plant superintendent charge field engineering construction, maintenance, 3 years; 7 years draftsman and designer, cement, concentrating mills, boiler, pump, compressor plants; most experience on piping, pumps, concrete and stress analysis, field maintenance and construction. Licensed structural engineer. Me-709.

MECHANICAL, 26, A.B., 1938. Three and a half years' experience refinery designs, construction. Seeks permanent position. Married. Now available. Prefer West Coast. Me-710.

MECHANICAL ENGINEER, experience of 25 years in design, construction, operation, and management of all classes of power plants and public utilities. Both mechanical and electrical training. Me-711.

MECHANICAL ENGINEER, professional, with proved inventive and executive ability. Long and thorough experience in invention and design of automatic machinery, chemical plant and equipment, automotive, special machinery. Me-712.

MECHANICAL ENGINEER, Columbia, A.B., M.E.; New England family; single; 25 years' experience, mainly work in power stations, personnel administration, writing; licensed professional engineer; now available for permanent work. Me-713.

MECHANICAL ENGINEER, B.S. in M.E., 30. Five years' experience as steam-turbine designer. Desires position on engineering staff of continuous-process or chemical industry. Maintenance, operation, or development. Now employed. Me-714.

[2] All men listed hold some form of A.S.M.E. membership.

POSITIONS AVAILABLE

ASSISTANT WORKS MANAGER, 40–50, preferably with M.E. degree, for leading industrial corporation to report to general works manager, on whom rests over-all responsibility for production. Must have ability to select, organize, and effectively direct kind of organization necessary to its successful accomplishment; accustomed to supervision of large groups of men; acquainted with problems inherent in both mass or line production and in special contract production; know machine tools and modern machine-shop operation; know standardization and methods, plant layout, cost finding, and budgetary procedure. Prefer suitable production experience in automotive field, calling for precision workmanship. $12,000–$18,000 a year. East. Y-9208.

MANUFACTURING ENGINEER, 35–50, preferably graduate electrical engineer or mechanical engineer with electrical experience, to develop into full responsibility for all manufacturing, as works or factory manager. Industrial engineer with radio-parts knowledge and management experience preferred, or superintendent in medium-sized plant having typical machine-shop operation and small-parts assembly departments experience. Should be accustomed to supervision of large groups of men, have broad acquaintance with production planning and control, standardization and methods, plant layout, cost finding, foreman training, and budgetary procedure. Salary, $8000–$10,000 a year. Middle West. Y-9209.

GRADUATE MECHANICAL ENGINEER with at least 10 years' experience in machine-tool industry to act as chief engineer in charge of design and development in high-precision small-mechanical-parts plant. Should have supervised designers and be able to get cooperation, hold confidence of mechanics. Permanent. $6000–$10,000 year. New Jersey. Y-9214.

EXECUTIVE MANAGER for toolroom and large machine shop, for manufacturing company. Previous experience in fine tool work absolutely essential, preferably with experience in companies in typewriter, cash register, or electrical-instrument fields. Salary $5000–$7500 year. Pennsylvania. Y-9215.

PRODUCTION MANAGER with good theoretical and practical background and particular experience in manufacture of instruments of products made up of large number of small accurate parts. Also several men whose training and experience fit them for inspection work. Salary open. Connecticut. Y-9225.

MECHANICAL ENGINEER, 30–45, for design, drafting work, and, when ability has been demonstrated, supervision over others. Should have good experience in machine-shop methods. Steel-plate-fabrication, structural-steel, or chemical-plant-design experience helpful. Western New York. Y-9227.

SUPERVISOR for large fabrication department with emphasis on production control. Applicant's background should feature "control" experience rather than mechanical. Connecticut. Y-9240.

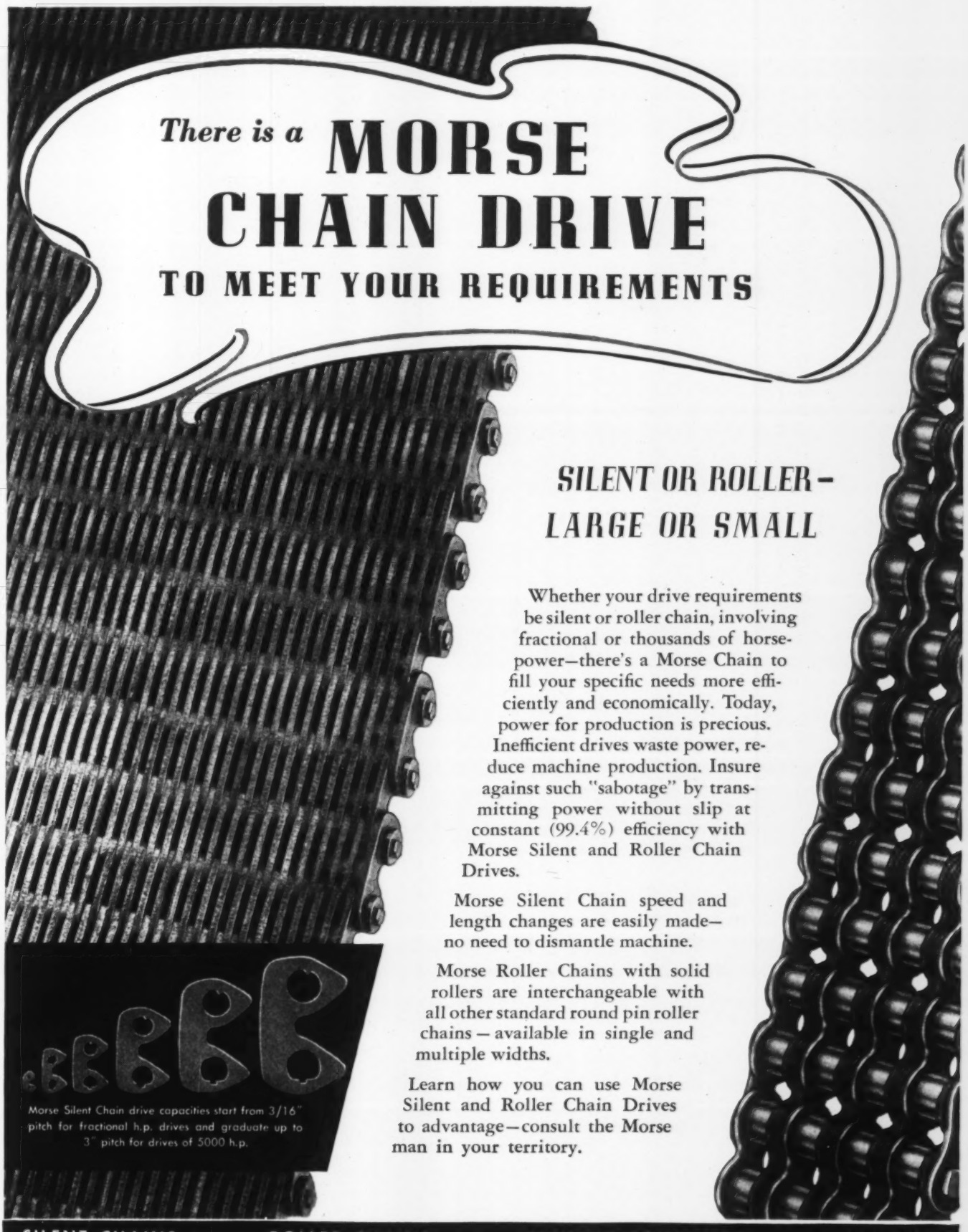
INDUSTRIAL ENGINEER, 30–45, with at least 3 years' time and motion-study experience. Also definite experience in all operations in steel foundry. Starting salary about $4800 year. Middle West. Y-9243-D.

TECHNICAL GRADUATE, preferably mechanical, electrical, or chemical engineer, 28–35, to edit publication of technical papers to be written by members of engineering personnel of company. Must have writing ability and have a definite proclivity for technical writing as he will write some of the papers himself. Knowledge of industrial instruments for measurement and control is essential. Desire

(*A.S.M.E. News continued on page 944*)

There is a **MORSE CHAIN DRIVE**

TO MEET YOUR REQUIREMENTS



Morse Silent Chain drive capacities start from 3/16" pitch for fractional h.p. drives and graduate up to 3" pitch for drives of 5000 h.p.

SILENT OR ROLLER— LARGE OR SMALL

Whether your drive requirements be silent or roller chain, involving fractional or thousands of horsepower—there's a Morse Chain to fill your specific needs more efficiently and economically. Today, power for production is precious. Inefficient drives waste power, reduce machine production. Insure against such "sabotage" by transmitting power without slip at constant (99.4%) efficiency with Morse Silent and Roller Chain Drives.

Morse Silent Chain speed and length changes are easily made—no need to dismantle machine.

Morse Roller Chains with solid rollers are interchangeable with all other standard round pin roller chains—available in single and multiple widths.

Learn how you can use Morse Silent and Roller Chain Drives to advantage—consult the Morse man in your territory.

SILENT CHAINS ROLLER CHAINS FLEXIBLE COUPLINGS CLUTCHES

MORSE *positive* DRIVES

MORSE CHAIN COMPANY ITHACA N. Y. DIVISION BORG-WARNER CORP.

experience in arranging for publication of such papers. Permanent, with good possibilities. Must be American citizen. Slight amount of traveling. Salary $2500–$3000 year. Connecticut. Y-9245.

PLANT ENGINEER to have charge of maintenance work of shop employing about 400 men; preferably with mechanical background for electrical and mechanical work and maintenance of plant. Knowledge of oil-fired boilers. Should have initiative and energy. New England. Y-9246.

INDUSTRIAL ENGINEER, not over 45; preferably someone with experience in woodworking plants, to act as associate with firm of consulting engineers. Must know organization and production planning, wage incentives, methods, and processes. Position permanent. Must travel. $4500–$5000 year. East. Y-9252.

FOUNDRY MAN with broad technical background and experience in designing permanent molds and casting aluminum alloys. Must be qualified to take charge of development and operations in foundry manufacturing high-quality castings. Write, giving qualifications and references, age, experience, and recent photograph. Pacific Coast. Y-9262-S.

MECHANICAL ENGINEER experienced in designing power plants. Salary, $5200 a year. Connecticut. Y-9279.

MECHANICAL ENGINEER, '35–40, capable of patent analysis on timing devices. Later capable of research, development on timing devices. Permanent. $4000 year. South. Y-9287.

MECHANICAL ENGINEERS, graduates of leading technical schools in U. S. Men well qualified to consult with industrial executives on modern production methods and plant improvements. Must be 5 ft 10 in. and preferably taller, have clean-cut appearance, and be capable of justifying salary of $5000–$8000 a year. New York, N. Y. Y-9293.

PRODUCTION ENGINEERS, with a general knowledge of manufacturing activities involving all types of machine-tool application. Should have at least 6 or 7 years' actual shop experience. Pennsylvania. Y-9313.

MECHANICAL ENGINEER for small diversified industrial research staff in heat- and corrosion-resistant alloys to design and operate test apparatus, do new product design, write reports, improve processes, some patent work. Good technical ability required. Salary $3000 year. California. Y-9319-S.

INDUSTRIAL ENGINEER with 4 to 5 years of good practical industrial engineering experience in time and motion study, labor material standards, general cost-reduction programs, etc., Pennsylvania. Y-9344.

RECENT GRADUATE MECHANICAL ENGINEER for process control division, where work is directed toward accumulation and analysis of operating control data and evaluation of such data for maximum obtainable results; also direction of activities of field men on specific problems; installation of new processes developed by research group from plant pilot to operational stages. Plant employs 900 men in type of operation controlled by instrumentation. Salary about $3600 year. South. Y-9347.

TECHNICAL DIRECTOR OR MANAGER for large textile-machinery company. Must be well trained in textile engineering and should know yarns thoroughly. Salary $8000–$10,000 a year. Northeast. Y-9354.

Candidates for Membership and Transfer in the A.S.M.E.

THE application of each of the candidates listed below is to be voted on after December 26, 1941, provided no objection thereto is made before that date, and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the secretary of The American Society of Mechanical Engineers immediately.

KEY TO ABBREVIATIONS

Re = Re-election; Rt = Reinstatement; Rt & T = Reinstatement and Transfer to Member

NEW APPLICATIONS

For Fellow

DOHERTY, ROBT. E., Pittsburgh, Pa.

For Member, Associate, or Junior

ABEL, WALTER L., Beverly, Mass.
ALDEN, HERBERT W., Detroit, Mich. (Rt)
ALLEN, ROBT. C., Milwaukee, Wis.
ALTWEIN, DONALD W., Tacoma, Wash.
ATHERTON, HENRY B., Kansas City, Mo.
BEARD, GEOFFREY G., Mt. Lebanon, Pa.
BRETZ, FRANK E., JR., Joliet, Ill.
BUNZEL, HERBERT F. W., Peekskill, N. Y.
CHAPLIN, FRANK S., Philadelphia, Pa.
CLEMENT, GEORGE H., Santa Monica, Calif.
COLE, ROBT. R., Anniston, Ala.
CONNON, JACK A., Bayonne, N. J.
DIXON, JAMES, Ridgway, Pa.
DOBSON, WILSON J., Storrs, Conn.
EARL, THOS. C., New Orleans, La.
GAMACHE, JEAN, Montreal, Que., Can.
GRAY, DONALD D. A., Washington, D. C.
GREAVES, DONALD L., JR., New York, N. Y.
HAGGERTY, CHAS., Providence, R. I.
INFANGER, ARTHUR W., Cayuga, N. Y.
JACOBSEN, LYDIK S., Stanford University, Calif.
JANITSCH, ANTHONY D., Smiths Falls, Ont., Can.
JOBST, CONRAD, Toledo, Ohio
LEUTWILER, RICHARD W., JR., West Lafayette, Ind.
LINDENMEYER, RAY S., Evanston, Ill.
MARSH, W. D., Ft. Wayne, Ind.
MART, LEON T., Kansas City, Mo. (Rt)
MARTIN, MARVIN DEW., Oakland, Calif.
MEDLAR, LEWIS A., Philadelphia, Pa.
MITCHELL, CECIL G., Lawrence, Kan.
MITCHELL, CHAS. A., Cincinnati, Ohio
MITCHELL, FRANK K., Bronxville, N. Y.
MORGAN, REGINALD W., Allentown, Pa.
MORRIS, WALLACE R., Toronto, Ont., Can.
MULLER, GEO. J., Philadelphia, Pa.
NEW, WINSTON R., Philadelphia, Pa.
PRESCOTT, HAROLD E., San Francisco, Calif.
RAYNES, S. HERBERT, JR., Manoa, Pa. (Re)
ROBINSON, PHILIP J., Chicago, Ill.
RYDER, GEO., Brooklyn, N. Y.
SCHECHTER, JACK E., Brooklyn, N. Y.
SPENCER, FRANK W., Cleveland, Ohio
STALEY, DUWARD C., Dayton, Ohio
WANEK, ALEX. T. E., Washington, D. C.
WHEELER, JOHN E., Springfield, Ohio
WILLIAMSON, JOHN L., New York, N. Y.
WILLSON, EDWIN L., Philadelphia, Pa. (Rt)
WILSON, HENRY M., Cleveland, Ohio (Rt)
WOODS, PAUL H., Associated, Calif.
WOODRUFF, PAUL A., Salt Lake City, Utah

CHANGE OF GRADING

Transfers to Fellow

DAVIDSON, WARD F., New York, N. Y.
MUIR, R. C., Schenectady, N. Y.
STEVENSON, A. R., JR., Schenectady, N. Y.

Transfers to Member

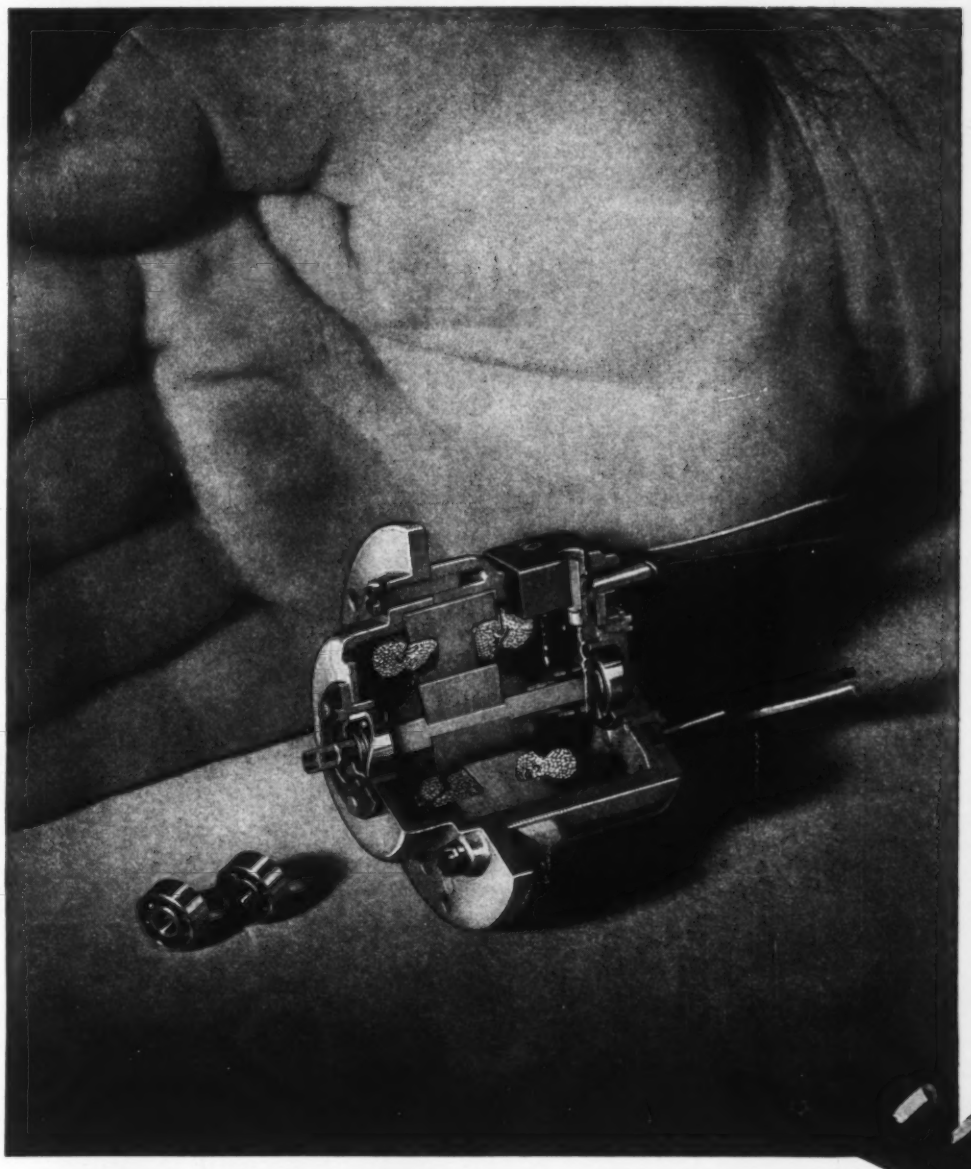
BEJARANO, JULIO G., Pittsburg, Calif.
BRADNER, ALTON F., Middletown, N. Y.
CONNER, NORVAL W., Raleigh, N. C.
DOLAN, THOS. J., Urbana, Ill.
EMHARDT, FRED W., Warren, Pa.
ERICKSON, RALPH E., Cleveland Heights, Ohio
FARRELL, EUGENE F., Detroit, Mich.
HABACH, GEO. F., Glen Ridge, N. J.
LONG, RICHARD H., San Francisco, Calif.
MOSER, KENNETH J., Bryn Mawr, Pa.
OLSON, ERNEST W., Swansea, Mass.
RYAN, JAMES J., Minneapolis, Minn.
TERWILLIGER, HAL R., Huntington, W. Va.
THUNEY, FRANCIS M., Washington, D. C.
TROTH, HUBERT C., Marion, Ind.

A.S.M.E. Transactions for November, 1941

THE November, 1941, issue of the Transactions of the A.S.M.E. contains:

Continuous Heat-Balance Control of Boiler-Room Operation, by B. S. Murphy
An Analysis of the Milling Process, by M. E. Martellotti
Calibration of Displacement Meters on Volatile-Liquid-Petroleum Fractions, by E. W. Jacobson
Treatment of Make-Up Water for the Waterside Topping Installation, by C. B. Arnold, R. T. Hanlon, and J. Mindheim
Adsorption Process for Removal of Soluble Silica From Water, by L. D. Betz, C. A. Noll, and J. J. Maguire
Silica in High-Pressure-Boiler Water, by Harold Farmer
The Flexible-Sleeve Multiple-Oil-Film Radial Bearing, by Gustave Fast
Progress Report on Tubular Creep Tests, by F. H. Norton
Interpretation of Creep Tests on Tubes, by C. R. Soderberg
Effect of Grain Size and Structure on Carbon-Molybdenum Steel Pipe, by A. E. White and Sabin Crocker

Engineering
Library



Nerves for BOMBERS

● Working in pairs, as transmitter and receiver, literally hundreds of these tiny Pioneer* Autosyn Motors in a large bomber tell the pilot the exact functioning of remote, vital parts of the ship.

Like the human nervous system, these motors must be quick-acting, sensitive. Hence, the use of two precise, ultra-sensitive New Departure ball bearings on each rotor shaft. These bearings are delivered to assemblers in oil-filled glass vials, untouched and uncontaminated by human hands.

This is only one phase of the defense effort for which New Departure is working night and day.

New Departure, Division of General Motors, Bristol, Connecticut.

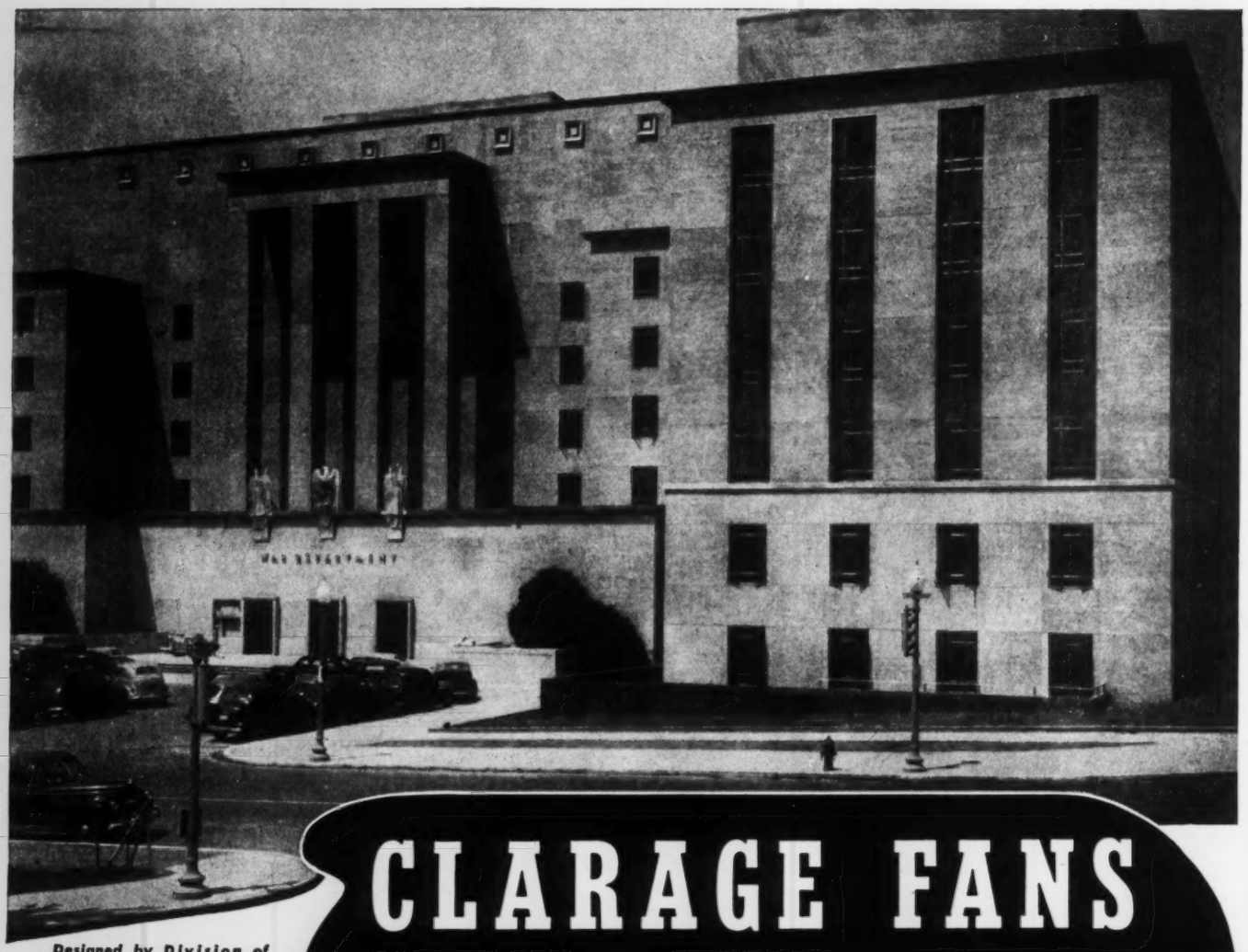
* *Pioneer Instrument, Division Bendix Aviation Corporation.*

New Departure

BALL BEARINGS FOR DEFENSE

3061

MECHANICAL ENGINEERING, December, 1941, Vol. 63, No. 12. Published monthly by The American Society of Mechanical Engineers, at 20th and Northampton Sts., Easton, Pa. Editorial and Advertising departments, 29 West 39th St., New York, N. Y. Price 60c a copy, $5.00 a year; to members and affiliates, 50c a copy, $4.00 a year. Postage to Canada, 75c additional, to foreign countries $1.50 additional. Entered as second-class matter December 21, 1920, at the Post Office at Easton, Pa., under the act of March 3, 1879. Member of the Audit Bureau of Circulations.



Designed by Division of Architecture and Engineering of the Public Buildings Administration, Washington.

General Contractor: John McShain, Inc., Philadelphia and Washington, D. C.

Air conditioning and heating contractor: Carlson Bros. of Michigan, Inc., Detroit.

CLARAGE FANS

Chosen for

NEW WAR DEPARTMENT BUILDING

WASHINGTON, D. C.

One of the 62 Clarage Fan installations in the New War Department Building, 21st St. and Virginia Ave., N.W., Washington, D. C. — seven stories high — 310,000 sq. ft. of floor space.

Clarage equipment is playing a vital role in National Defense — by supplying conditioned air in important buildings as shown above, and by air conditioning, ventilating and heating industrial plants from coast to coast where planes, tanks, guns and other war requisites are being manufactured.

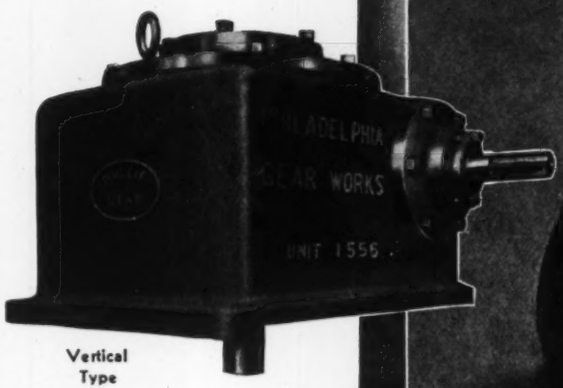
If you have any type of air handling problem, Clarage can solve that problem satisfactorily and with economy.

Back of Clarage products is more than a quarter-century of engineering and application experience. A Clarage recommendation can be relied upon! See your Sweet's Catalog File, or write us for any desired information.

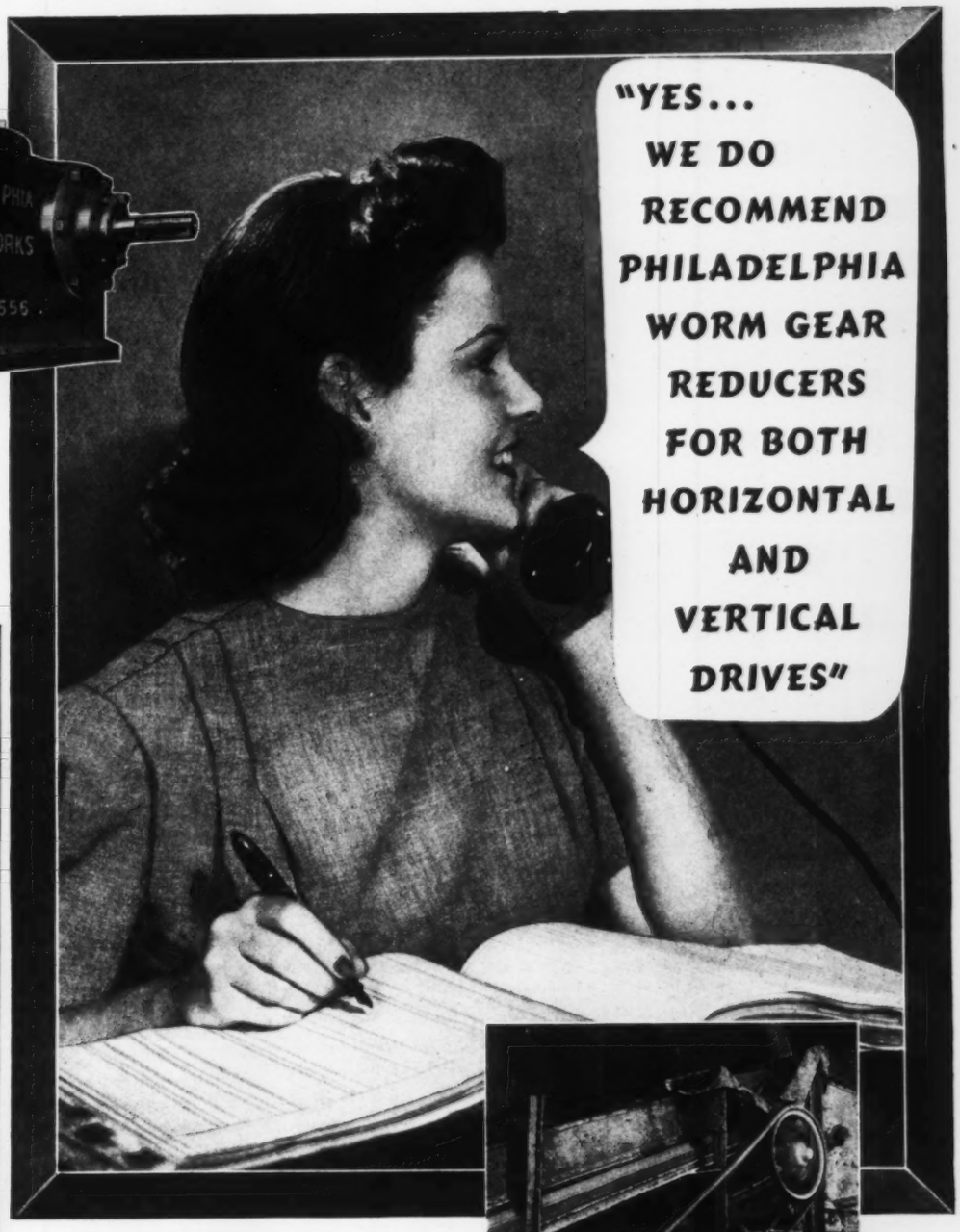
COMPLETE AIR CONDITIONING
•
COOLING
•
VENTILATION
•
FACTORY HEATING
•
MECHANICAL DRAFT
•
FANS and BLOWERS for INDUSTRIAL NEEDS

CLARAGE FAN COMPANY—KALAMAZOO, MICH.

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES

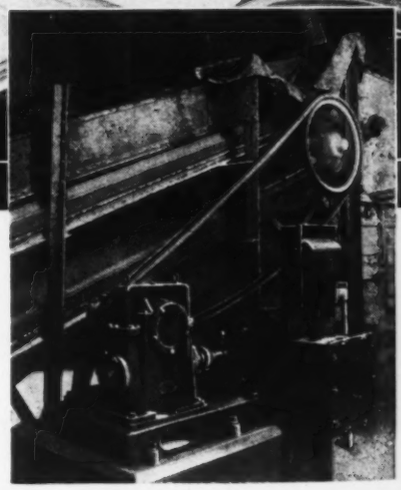


Vertical Type



"YES... WE DO RECOMMEND PHILADELPHIA WORM GEAR REDUCERS FOR BOTH HORIZONTAL AND VERTICAL DRIVES"

Philadelphia LIMITORQUE CONTROL operates all types of valves, etc., safely, economically, from convenient stations.
Philadelphia WORM GEAR SPEED REDUCER right angle drives—vertical or horizontal. Wide range of ratios and horsepowers.
Philadelphia HERRINGBONE SPEED REDUCER for heavy loads at high speed. Single, Double, Triple Reduction, many ratios, ratios and horsepowers.
Philadelphia MOTOREDUCER The economical self-contained drive. Horizontal or Vertical types—various ratios and horsepowers.
Philadelphia GEARS All types and sizes of industrial gears. Can be supplied in all materials.



Horizontal Type driving Conveyor

Philadelphia Worm Gear Speed Reducers have been preferred for years in many lines of industry as the dependable means of transmitting a high proportion of input power at right angles . . . either horizontal or vertical. They operate with almost no attention save occasional lubrication and they can be supplied in a wide range of horsepowers and ratios.

For today's all important production requirements, where there is no time to coddle your equipment, it pays well to install these drives that have been proven through the years. Write today for more details.

PHILADELPHIA GEAR WORKS

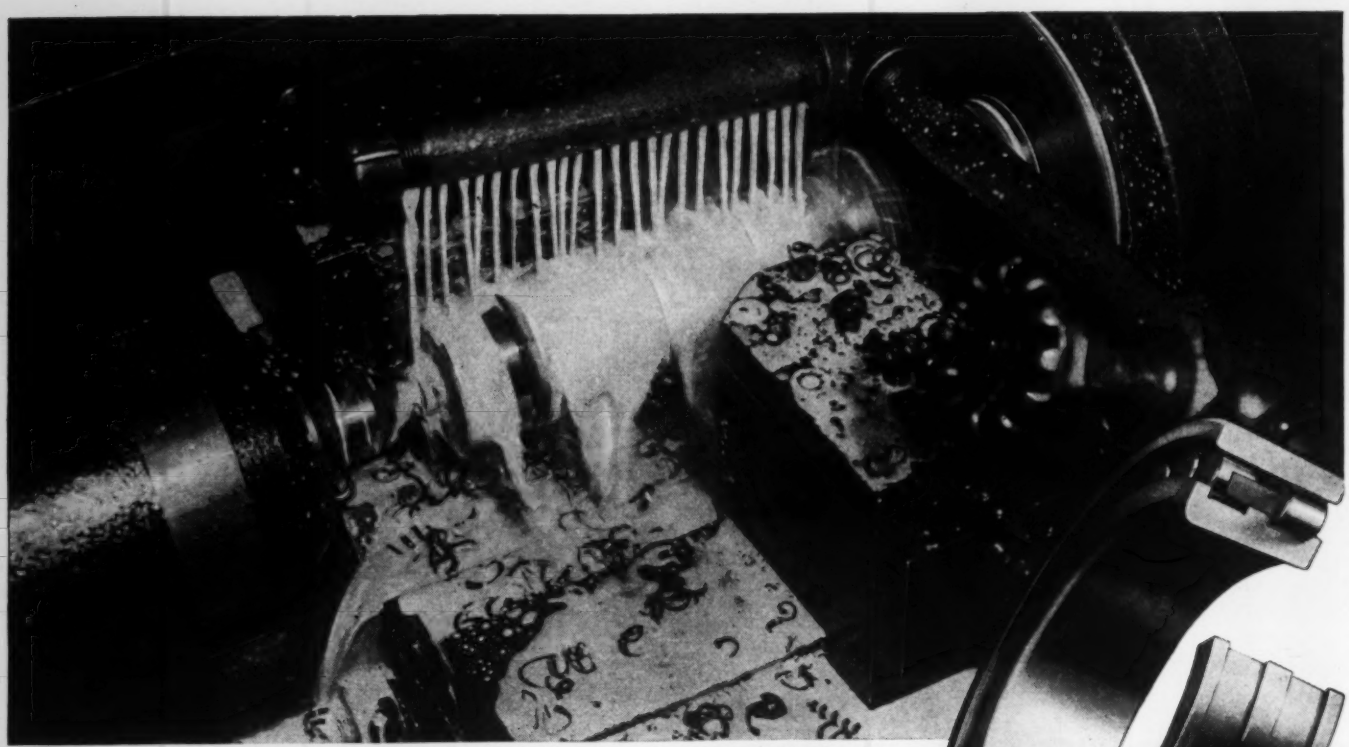
Industrial Gears and Speed Reducers

Erie Ave. and G St.

Philadelphia, Pa.

•

New York • Pittsburgh • Chicago

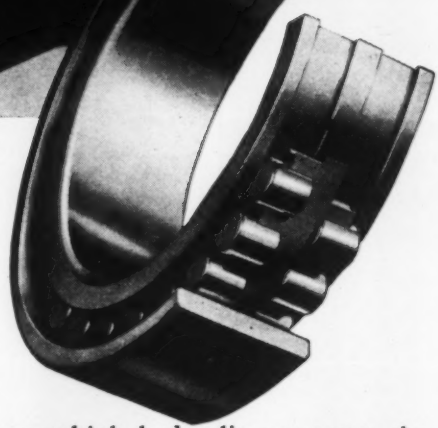


• *Turning shells on an SKF -equipped Blood lathe in the plant of S. A. Woods Machine Co.*

More shells ON . . .

From the front lines of Defense, the word's flashed back for "More shells!" And this Blood lathe in the plant of S. A. Woods Machine Company strives to keep pace. As one shell is turned, another takes its place, and another, and another.

Meanwhile, SKF Bearings are helping this lathe to meet the exacting demands imposed upon it. On the headstock, a double row cylindrical roller bearing takes the radial loads, and a thrust bearing the thrust loads at the work end. A deep groove ball bearing absorbs both radial and thrust loads on the rear location.



To counteract high hydraulic pressures, the tailstock is designed with three angular contact bearings mounted in tandem to provide adequate capacity. The double row cylindrical roller bearing at the front provides radial capacity and rigidity in a confined space.

Together, they prove that Modern Design helps America move ahead in Production.

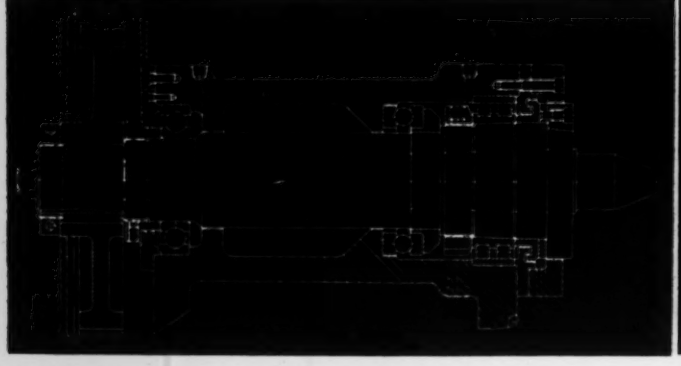
SKF INDUSTRIES, INC., PHILA., PA.

4937

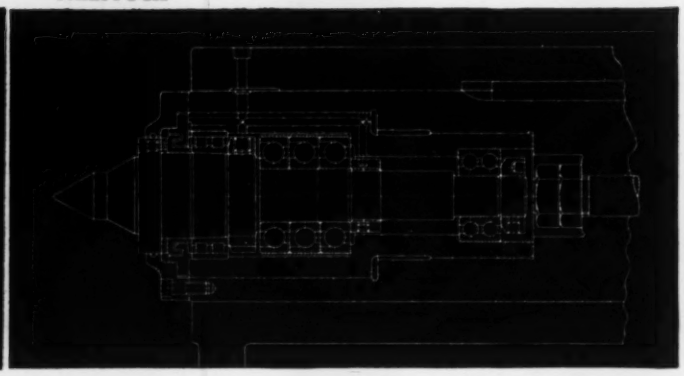
SKF

BALL AND ROLLER BEARINGS

•HEADSTOCK

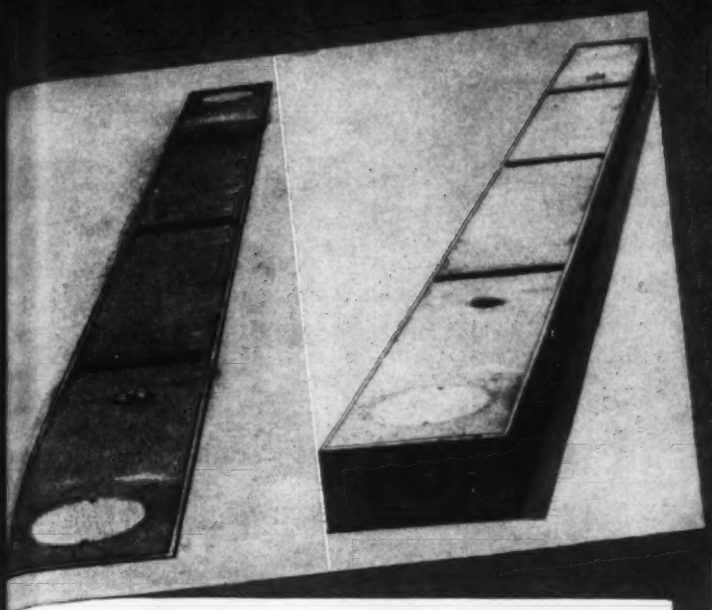


•TAILSTOCK



HYCON

Makes 1 HP do the work of 100 HP



On some Hycon installations, such as this traffic fin, as much as 100 hp is supplied for 15 seconds by a Hycon storage tank operating in connection with a Hycon pump and a 1 hp motor. Other Hycon applications include the operation of brakes, clutches and steering devices on heavy vehicles . . . the control of machine tools . . . the testing of high pressure apparatus . . . and the actuation of remote control circuits.

HYCON Control System provides designers with a dependable means of using stored hydraulic energy (in working ranges up to 3000 psi) to control and actuate straight line motion.

One of the advantages this offers (illustrated by the application above) is power far in excess of the pump's capacity and independent of its operation. Others are: power insurance when the prime power source fails; the elimination of power waste involved in constant pumping; and the use of smaller motors or less costly power sources in applications requiring intermittent operation.

Important as these advantages are to today's emergency they are no less vital to the era of industrial reconstruction which will follow. So if you face the problem of securing more positive, powerful or economical control over straight line motion mechanisms . . . get the full facts on Hycon now

Functions of the Hycon System

A typical hydraulic circuit is shown in relation to the illustration of the HYCON brake system using a motor driven pump. The pressure delivered by (A) the pump to (C) the pressure tank *which acts as a storage battery for storing hydraulic energy* is automatically regulated by (B) the suction control valve.

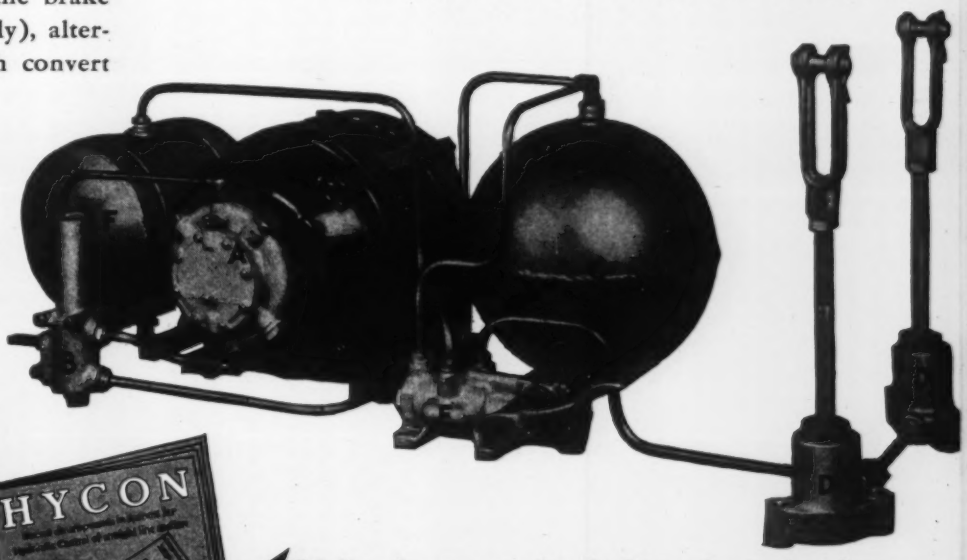
This shuts off the intake to the pump when standard pressure is attained in the pressure tank; (E) the brake control valve (actuated manually or automatically), alternately connects (D) the work cylinders (which convert hydraulic pressure into straight line action) to the pressure tank and to (F) the sump tank (which collects fluid discharged by the work circuit for re-pumping to the storage tank).

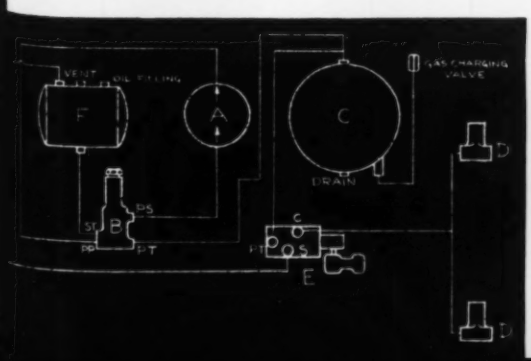
The fluid thus delivered to the work circuit builds up a pressure therein which is at all times strictly proportional to the movement and effort exerted on the valve lever.

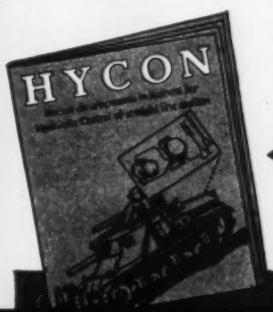
HYDRAULIC CONTROLS, INC.

(DIVISION OF THE NEW YORK AIR BRAKE COMPANY)

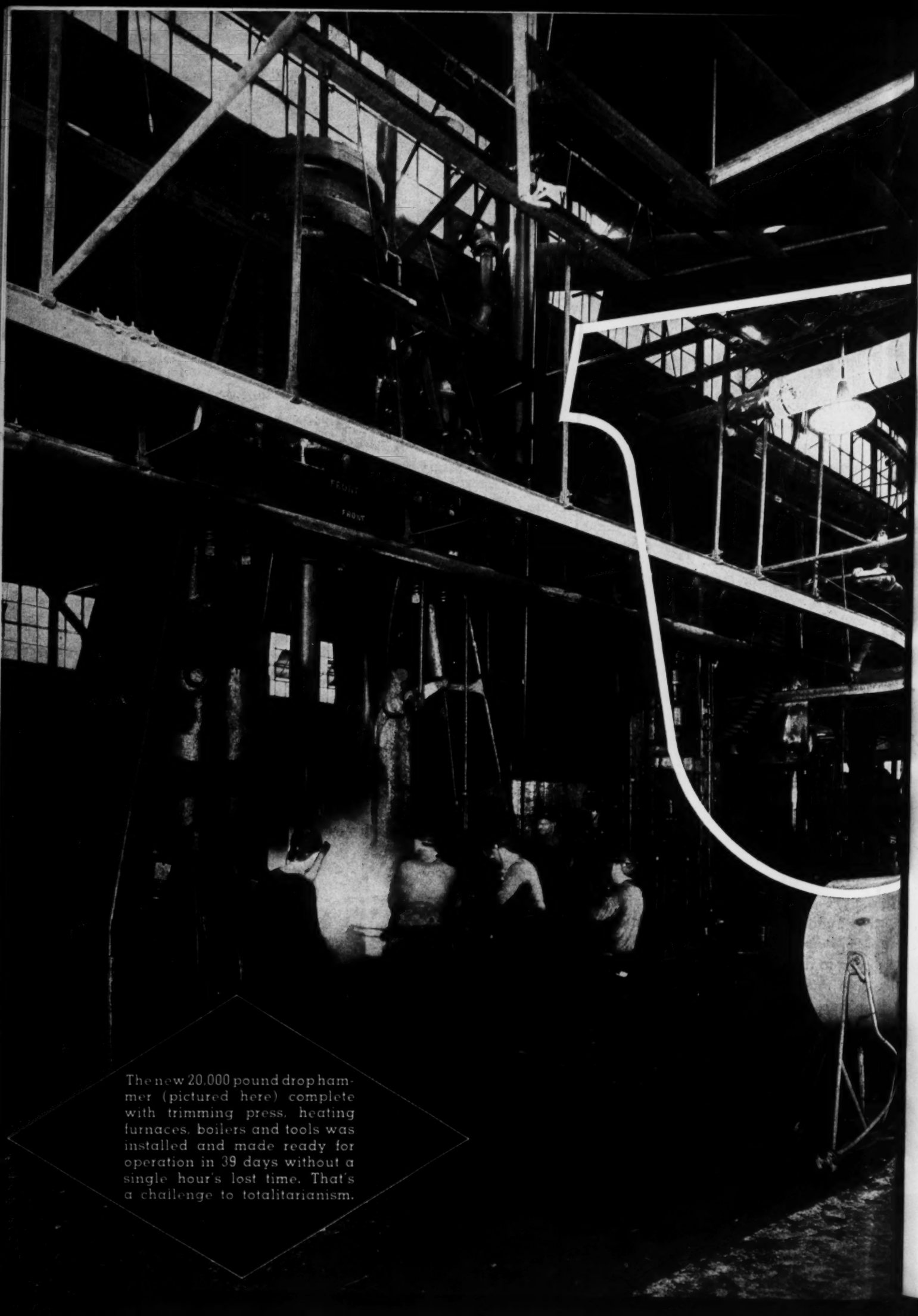
122 South Michigan Avenue, Chicago, Illinois, Dept. 109



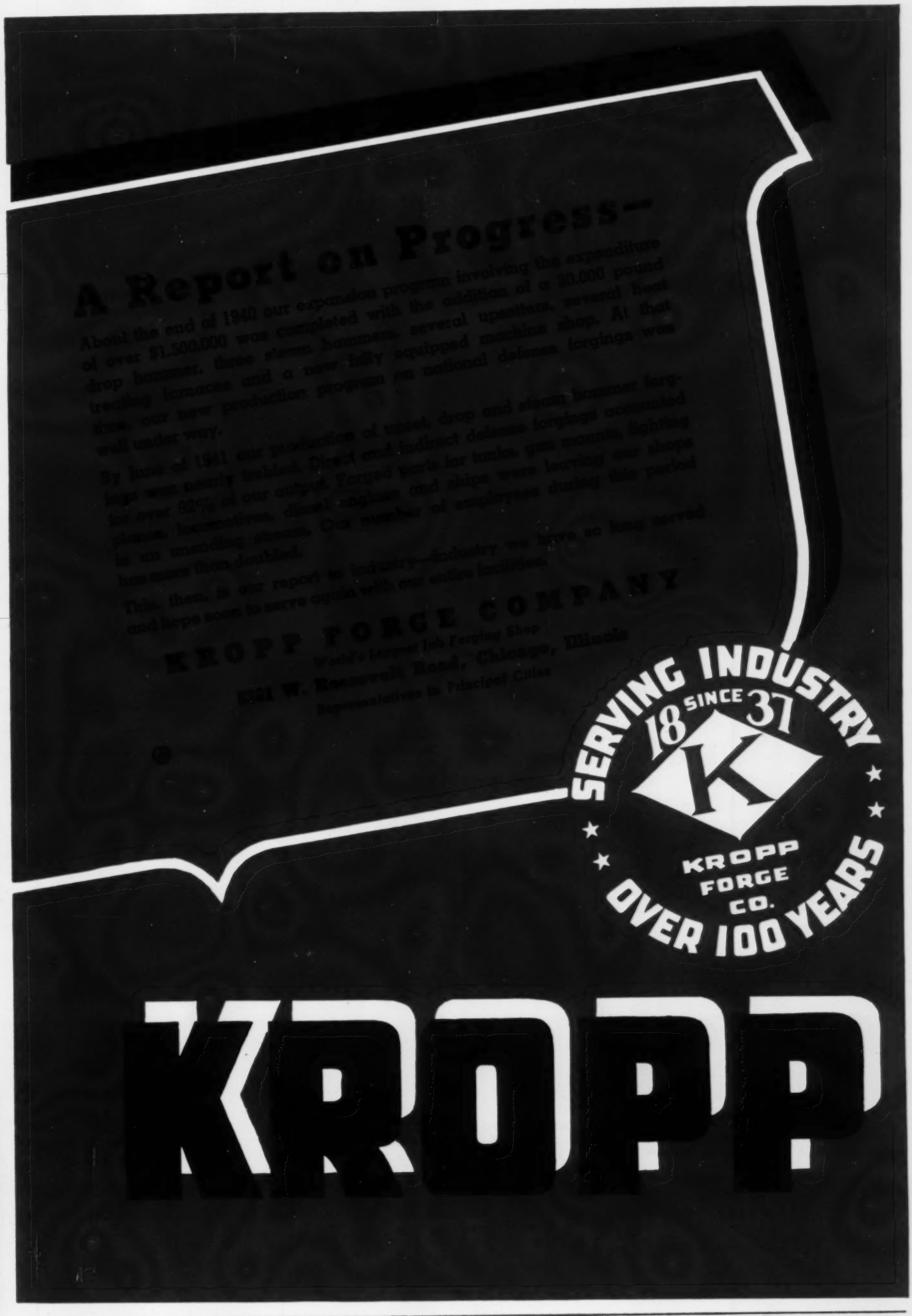




Salient facts concerning the Hycon System have been condensed into a booklet titled, "Recent Developments in Systems for Hydraulic Control of Straight Line Motion." Please let us know where to send your copy.



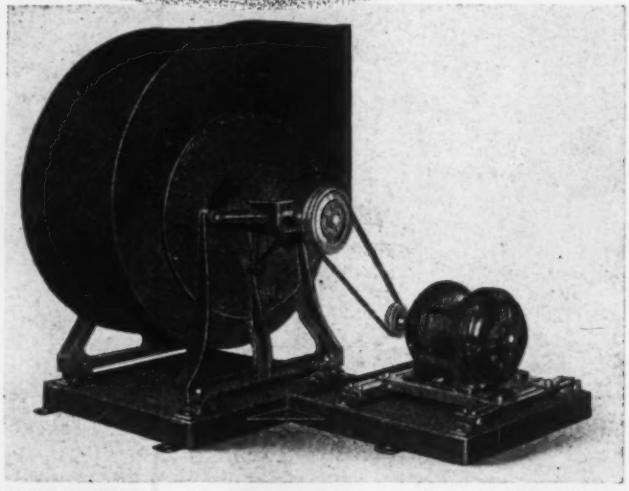
The new 20,000 pound drop hammer (pictured here) complete with trimming press, heating furnaces, boilers and tools was installed and made ready for operation in 39 days without a single hour's lost time. That's a challenge to totalitarianism.


A Report on Progress—
About the end of 1940 our expansion program involving the expenditure of over $1,500,000 was completed with the addition of a 20,000 pound drop hammer, three steam hammers, several upsetters, several heat treating furnaces and a new fully equipped machine shop. At that time our new production program on national defense forgings was well under way.
By June of 1941 our production of upset, drop and steam hammer forgings was nearly trebled. Direct and indirect defense forgings accounted for over 92% of our output. Forged parts for tanks, gun mounts, fighting planes, locomotives, diesel engines and ships were leaving our shops in an unending stream. Our number of employees during this period has more than doubled.
This, then, is our report to Industry—Industry we have so long served and hope soon to serve again with our entire facilities.
KROPP FORGE COMPANY
World's Largest Job Forging Shop
2501 W. Roosevelt Road, Chicago, Illinois
Representatives in Principal Cities
SERVING INDUSTRY
18 SINCE 37
K
KROPP FORGE CO.
OVER 100 YEARS
KROPP

EVERY CUBIC FOOT OF AIR *has a job to do!*

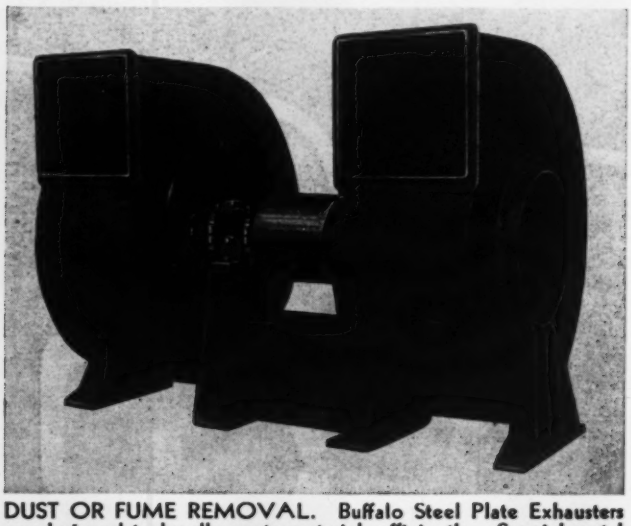
● There's no place for lazy air in today's stepped-up production program! Air—effectively controlled—helps speed up workers' efficiency thru correct ventilation and warmth . . . controlled air whisks away dust, dirt, corrosive fumes . . . controlled air provides unfailing draft to boilers. All vital services—all handled by built-for-the-job Buffalo Fans with dependability that can be counted on for years. Have you an air handling problem? Call in Buffalo.

BUFFALO FORGE COMPANY
148 Mortimer St. Buffalo, N. Y.
Branch Engineering Offices in Principal Cities
Canadian Blower & Forge Co., Ltd., Kitchener, Ont.



VENTILATION. Ventilating and air conditioning fans should operate quietly, smoothly. Buffalo Limit-Load Fans have those characteristics plus high efficiency. Bulletin 3099.

FORCED & INDUCED DRAFT. Fans for this all-important service must have flexibility of control *plus* dependability. You find these features in Buffalo Fans. Bulletin 3113-A.

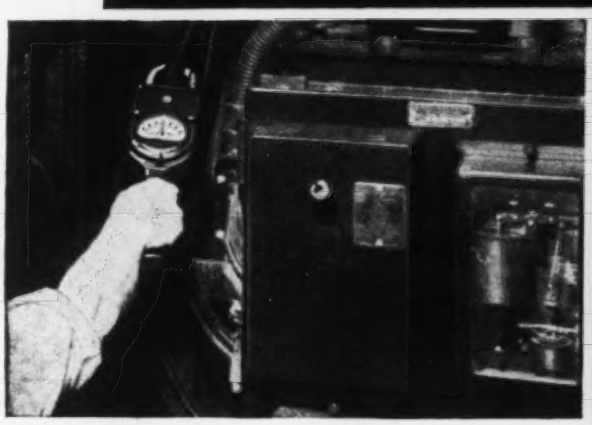


DUST OR FUME REMOVAL. Buffalo Steel Plate Exhausters are designed to handle waste materials efficiently. Special metal construction or rubber lining when necessary. Bulletin 2678-C.

"Buffalo" **FANS FOR INDUSTRY**

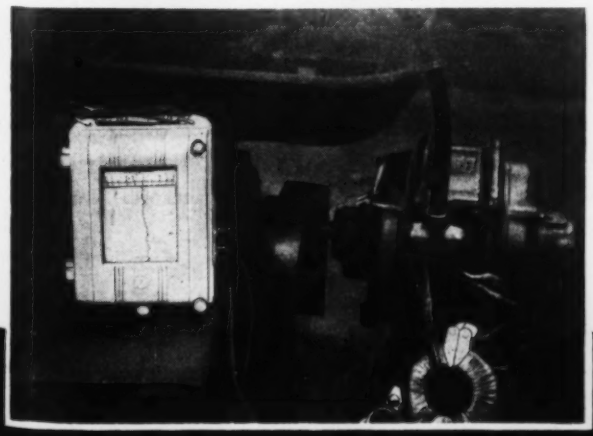
Type AK-1
hook-on volt-ammeter

How These Hook-on Instruments Can Help Keep Production Rolling

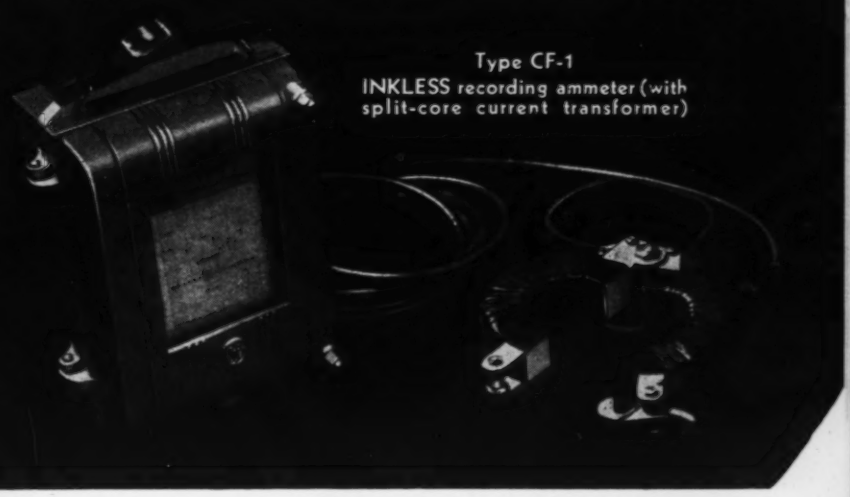


The AK-1 is made for tight places. Here it is being used for a quick, easy measurement of voltage-regulator current.

Measuring a-c VOLTS and AMPS. Hook it around a conductor to measure amperes. Connect the voltage leads (as shown above) to measure volts. With this one setup, you can make either measurement just by flicking the selector switch.



Checking motor load with the CF-1 recording ammeter and split-core current transformer.



Type CF-1
INKLESS recording ammeter (with split-core current transformer)

1. The ease of making tests encourages routine testing and promotes good maintenance, which prevents production delays.

2. Emergency tests can be made without cutting conductors—thus avoiding shutdowns.

TODAY, when motors and other electric equipment are being taxed to the limit and may be overloaded, frequent testing of circuit conditions will often avert serious production delays. These instruments will take care of almost all your testing work.

The volt-ammeter is ideal for emergency tests where a fast check of circuit conditions is needed. It measures both VOLTS and AMPERES. Having six a-c ranges, it's really six instruments in one —0-15/60/150/600 amperes and 0-150/600 volts.

The INKLESS feature of the recording ammeter makes it the handiest of recorders for general plant maintenance. With no pen to start and no inkwell to fill, it's ready to be hooked around a conductor and start recording at a moment's notice.

You're overlooking a good bet if you don't have both these handy G-E instruments for emergency and maintenance testing.

For complete information on the volt-ammeter, ask for Bulletin GEA-2950; on the recorder, GEA-3187. Your G-E office has copies. General Electric, Schenectady, New York.

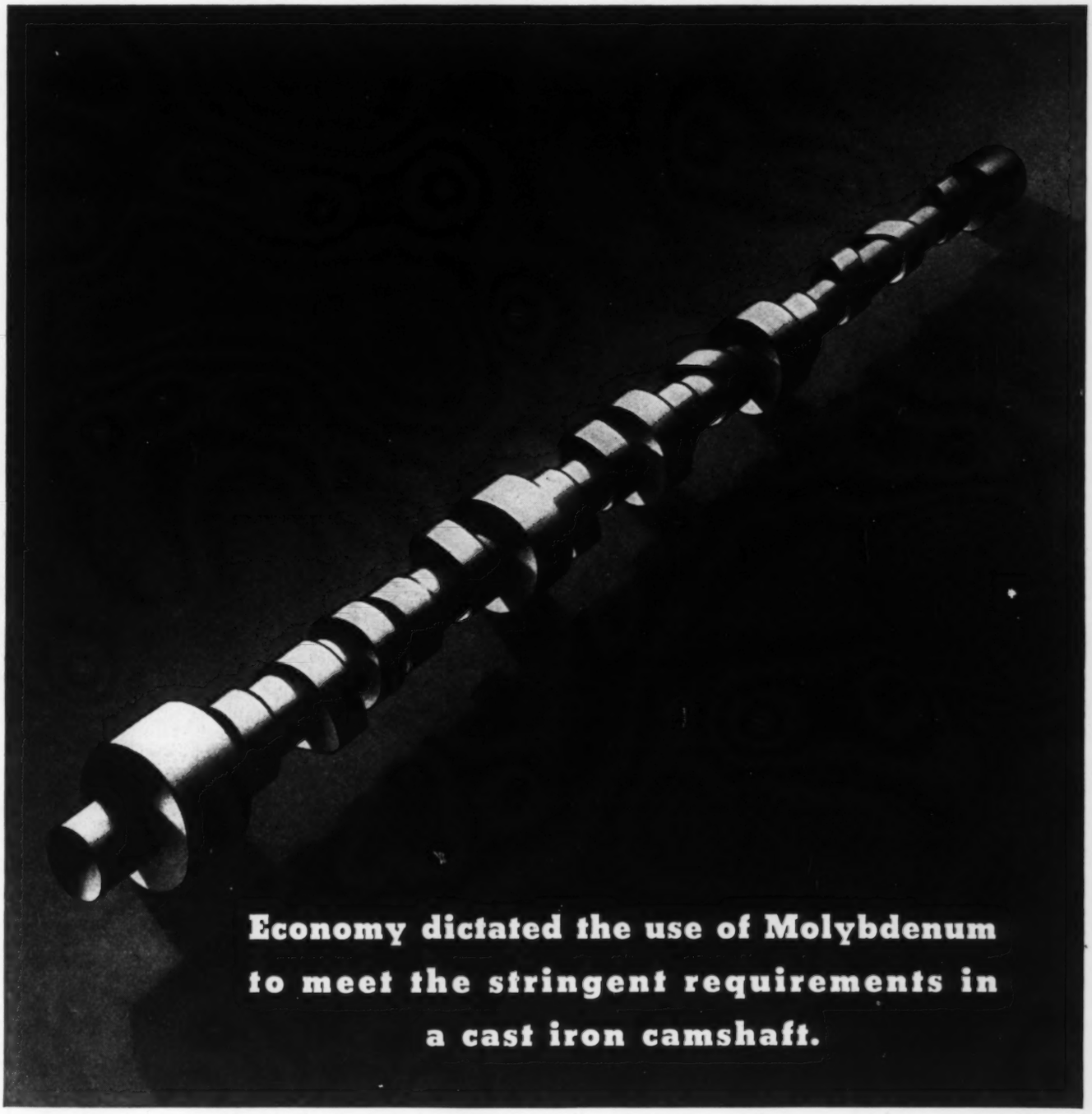
GENERAL ELECTRIC

★ ★ ★

NICKEL

Practical answers to many questions about the selection, fabrication and uses of Nickel alloys are quickly available to you. This helpful information we have gathered, checked and condensed into convenient printed form. It is useful both to experienced men handling new materials or performing unfamiliar operations... and to new employees. This literature is available upon request. You are also offered the assistance of our technical staff in solving material problems arising from a temporary lack of Nickel. Our engineers are offering timely suggestions to many vital industries during the present emergency. Your request for literature or personal consultation will receive our prompt attention.

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK, N. Y.



Economy dictated the use of Molybdenum to meet the stringent requirements in a cast iron camshaft.

The automotive industry requires certain minimum physicals, plus wear resistant properties, to make practical a cast iron camshaft. Machinability also, of course, is a factor.

The Chromium-Molybdenum-Nickel (0.40-0.60% Mo) iron which resulted from the search for the ideal, has an as cast tensile strength of 50,000 p.s.i., is rigid enough for the requirements and tough enough to stand up under the operating conditions.

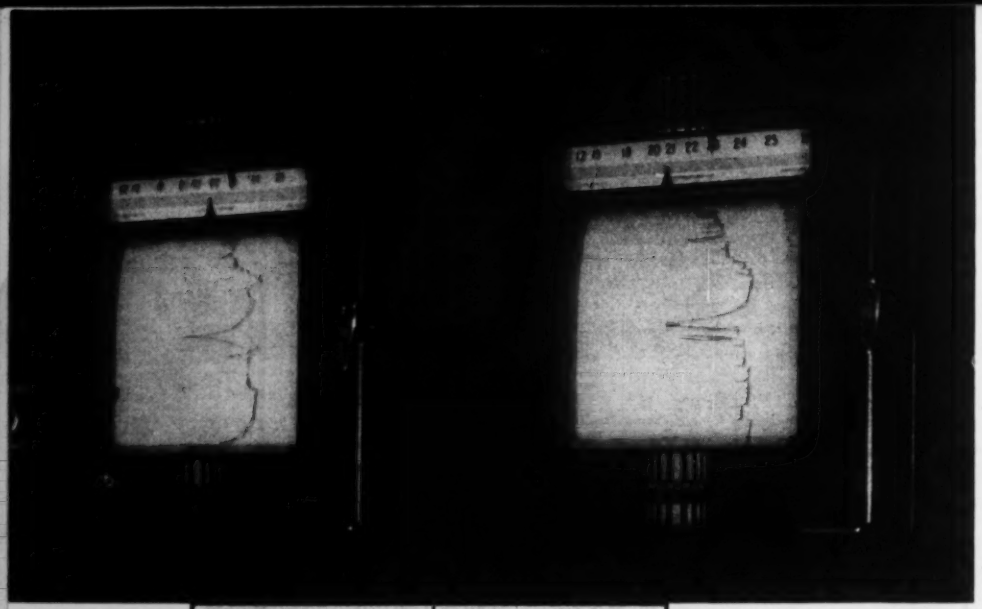
The analysis of the iron makes possible economical, efficient flame hardening of the cams, with a good, strong case to core bond.

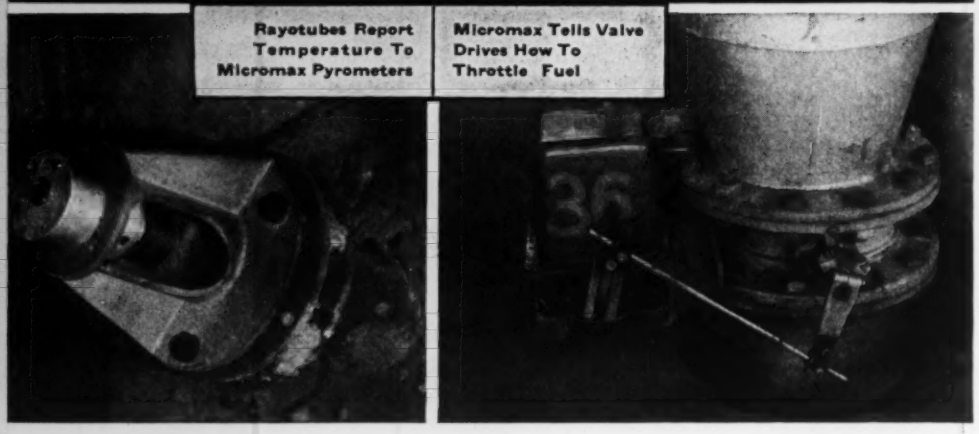
Ask for our free technical book, "Molybdenum in Cast Iron", giving full practical data.

CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS. MOLYBDIC OXIDE BRIQUETTES FOR THE CUPOLA—FERROMOLYBDENUM FOR THE LADLE

Climax Molybdenum Company
500 Fifth Avenue • New York City

MOLY





HEAT HUGS INGOTS PROPERLY

When Micromax-Rayotube Pyrometers Are Used

In the soaking of ingots at various steel mills, there are two features which add interest to the Micromax Pyrometer control of temperature in the pit furnaces:

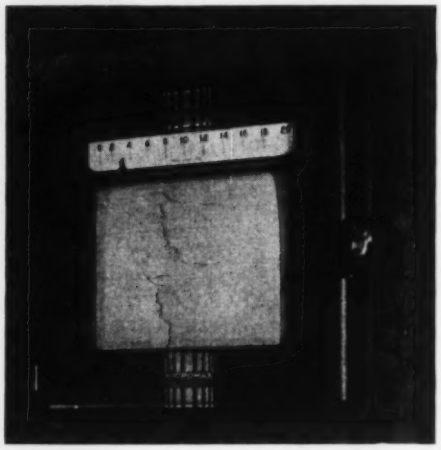
First, the temperature is held in line without either sudden or rhythmic variations. Every change in temperature brings its own correction, but the correction is in strict proportion to the size of the change; big corrections when the furnace is opened; tiny ones as radiation, etc., affect temperature. The fuel valves act as they would if an expert heater kept his hands on them and his eye glued to a pyrometer, hour in and hour out, day after day. This "floating" action gives the flexible, dependable, accurate control required for ingots of various but rigid analyses, with various specifications for heating.

The second vital feature of this Control is that temperature is detected by Rayotube radiation units, instead of by thermocouples. Rayotubes last many times as long as couples at high temperatures, and cannot be struck by the ingots when the furnace is being loaded or unloaded. And Rayotubes make the control more sensitive, which is particularly valuable in view of the sudden changes in load to which any pit is subjected.

For further information about Micromax-Rayotube pyrometers for other furnaces, see Catalog N-33B.

Fuel Efficiency Upped With Help of CO_2 Recorder

One of the many ways in which fuel efficiency is maintained in several modern steel mills is by the use of Micromax CO_2 recorders. Application is generally at the flue to the waste-heat boiler, with the recorder on the furnace's control panel.



A typical case is that of the Roebling mill, in which the Recorder shown was photographed. The Company purchased this first Micromax shortly after it was announced as a new instrument. It went to work in a distinctly "make-good-if-you-can" atmosphere. It did make good; CO_2 has joined the other conditions which are known with dependable accuracy. Another user of Micromax CO_2 Recorders is Jones & Laughlin, with four round-chart instruments giving excellent service in connection with S-C pit furnaces.

A range of 0 to 30% CO_2 is often specified for this service in steel mills, but other ranges are available, and the instruments use substantially the same mechanism as do Micromax pyrometers. For further information on Micromax CO_2 Recorders, see Catalog N-91-163, sent on request.

New! Automatic! Micromax Indicator For Temperature

For checking the temperatures of various thermocouples, in any desired order and with the "human equation" largely eliminated, we recommend the Model S Micromax Indicator. The equipment is particularly useful where a large number of couple temperatures must be logged by a process operator.

This instrument is our motor-driven potentiometer pyrometer, with recording omitted and provision added for checking any number of couples up to 77. To check a couple, the user simply snaps its little toggle-switch, and the instrument points to temperature.

The case of the Indicator is same as that of the Model S Micromax Recorder or Recording Controller. Indicator has automatic reference-junction compensator, manual standardizer. All switches are accessible without opening case. For further details, see Catalog N-33A(5).

Jrl Ad ENT-0600C(27)

LEEDS & NORTHRUP COMPANY, 4963 STENTON AVE., PHILA., PA.

LEEDS & NORTHRUP

MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

• Keep Informed . . .

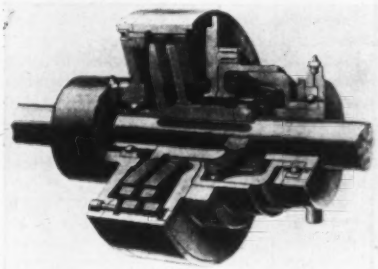
Announcements in this section are supplied by current advertisers in MECHANICAL ENGINEERING and A.S.M.E. MECHANICAL CATALOG. This section is restricted to these advertisers.

- *NEW EQUIPMENT*
- *BUSINESS CHANGES*
- *LATEST CATALOGS*

Available literature may be secured by addressing a request to the Advertising Department of MECHANICAL ENGINEERING or by writing direct to the manufacturer and mentioning MECHANICAL ENGINEERING as a source.

• NEW EQUIPMENT

Torque-Master Friction Clutch



Recently announced by T. B. Wood's Sons Co., Chambersburg, Pa., the Torque-Master Friction Clutch combines every advantage known today in clutch design. Available in single and multiple disc types and in a wide range of sizes, the Torque-Master is designed for the heaviest type of work, impact and pulsating loads. With all parts totally enclosed, it combines safety at high speed with inherent dependability under all operating conditions. As indicated in the illustration, friction plates are of gear tooth design, while the entire operating mechanism is simple, sturdy and consists of only a few moving parts. All adjustment for wear or load conditions is made with one knurled hand adjusting ring—no special tools needed.

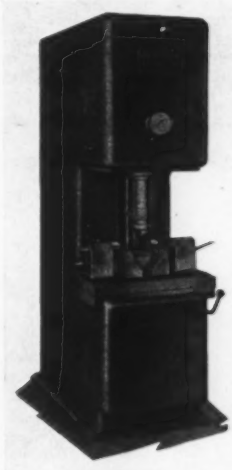
New Water Pump Seal

In announcing this new Bellows-type Seal, the Crane Packing Co., 1800 Cuyler Avenue, Chicago, Ill., manufacturers of "John Crane" Seals for more than a quarter century, list the following as principal features: (1) Seal has only 2 parts: bellows and spring. Bellows is an exclusive synthetic rubber compound found to be superior to any other for sealing services; grease, oils, salt water, alcohols and anti-freeze do not affect it. (2) Installed partially compressed; ready for instant seal. (3) Entire unit (bellows and spring) is spring driven and operates as a driving coupling. Seal does not touch or have a sliding contact with the shaft: rust, corrosion and deposit do not interfere with or reduce efficiency. (4) Bellows connects two flanged ends. Spring is placed in a fixed position against the inside shoulders of the flanged ends and so holds the contact facings against the sealing washer on the one end and the driving base on the other. (5) Because of the seal's ability to flex and compress as a unit, pressure variation, misalignment, fan thrust, torque or vibration set up by an unbalanced impeller, are automatically accommodated or compensated for. (6) The serrated contact facings are responsible for the positive seal at both the washer and driving base points. These facings are formed in a series of concentric grooves and flat-faced ribs, effecting seal with a suction-action. (7) Among other advantages is "blind-fold" installation. Seal cannot be installed wrong either on the assembly line or in the field. Both ends are identical—either end is right.

Samples and data furnished on request to automotive and industrial pump engineers and designers.

"HydrOILic" Press for Straightening Steel Shafts

To correct irregularities of a few thousandths of an inch in short, hardened steel shafts is not only a delicate job but also a tough one. But it is a job reported to be accomplished by the special tooling of a standard 15-ton, C-type Denison HydrOILic Press. The press is known as their model DLAC2.



With the ram of the press raised, a shaft is fixed between centers. Gauges, calibrated in thousandths of an inch are moved along the shaft until they indicate a point where straightening is needed. Then the press ram, operated by the control lever, is advanced to the shaft and centers are lowered with the shaft to the straightening block. Additional movement of the control lever applies the tonnage that straightens the shaft.

The gauges measure the shaft after tonnage has been applied, and before the shaft is released. They work swiftly with unerring accuracy. Feather-light pressure on the operating lever controls the movement of the ram, and the tonnage applied is in direct proportion to the movement of the lever.

The manufacturer further reports that this particular tooling setup, as well as the operation it is performing is only illustrative of the adaptability of this particular press. To aid manufacturers in getting the greatest possible utility from this press, the company has also issued a bulletin giving details and illustrations of a number of ways the unit can be tooled for performing pressing operations other than the one for which the press was originally designed. A copy of this bulletin will be sent, without obligation, by writing direct to The Denison Engineering Co., Chestnut and McCony Streets, Columbus, Ohio.

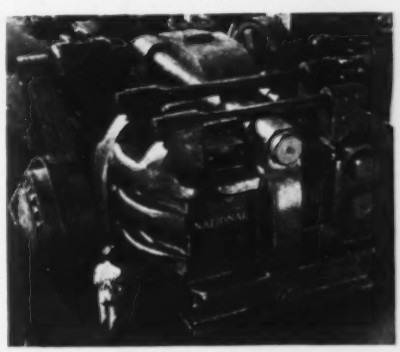
New Lid-Lifter Design Improves Homocarb Cooling Unit

An improved lid-lifter is now incorporated in the Homocarb cooling unit. It consists of a lever acting on a roller-fulcrum, gives an easy, horizontal lift that simplifies this operation for the heat-treater. Ruggedly constructed for long service, it is typical of design improvements which are continuously being made on Leeds & Northrup furnaces to benefit the user.

This cooling unit expands the capacity of the Homocarb furnace equipment which gives the heat-treater "4-factor" control and enables him to carburize to exact specification. For more complete information about the Homocarb Method for Carburizing, write to Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia, Pa., for Catalog T-623.

World's Largest Forging Machine Received by Tube-Turns, Inc.

Widespread attention is being focused on the current delivery of the world's largest forging machines, one in November and the other in February to Tube-Turns, Incorporated, manufacturers of Tube-Turn welding fittings, at Louisville, Ky.

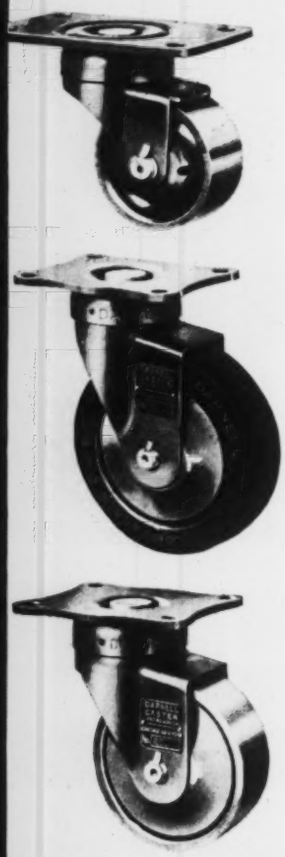


Because these mammoth forges represent a far-reaching development in the scope and

Continued on Page 18

YOU CAN DEPEND ON Darnell Casters

DARNELL CASTERS & E-Z ROLL WHEELS



at your SERVICE

Reduce Floor Wear to a minimum.

Increase efficiency of employees.

Eliminate wracking of equipment.

Save time, speed up production.

WRITE FOR DARNELL MANUAL

Darnell Corp., Ltd.
LONG BEACH, CALIFORNIA
36 N. CLINTON ST., CHICAGO
60 WALKER ST., NEW YORK CITY

• Keep Informed . . .

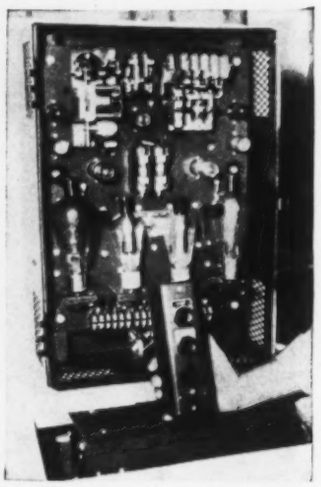
capacity of forging operations, U. S. industry and defense bodies are keenly interested in their performance at Tube-Turns, Inc. Here they will be put to work immediately in the production of airplane motor cylinder forgings and other vital armament needs included in the defense orders held by this company.

These two huge forges are rated at 9" capacity—a feat of designing and construction viewed as impossible a few years ago. Some idea of their size and potentialities may be gained from these figures. Each machine weighs over 500,000 lbs., and requires well over a year to build. One of the most significant features is the extreme compactness, which can be visualized by considering that the weight of each machine is greater than the combined weight of 140 automobiles. If parked end to end, these cars would extend for more than half a mile—yet this unit occupies floor space sufficient to accommodate only four cars.

According to Tube-Turns, Incorporated, this unique compact design—for a machine of such tremendous size and capacity—insures the exacting accuracy, precision and speed in the forging work for which it will be used.

General Electric Announces New Electronic Motor Control

As an outgrowth of its thyratron speed control for d-c motors, the General Electric Co. has announced a new electronic control system—called Thy-mo-trol—to provide simple, stepless control of direct-current motors from alternating-current lines wherever a wide speed range is needed.



With this new development, the flexibility of d-c motors can now be combined with the economy and convenience of a-c power distribution. The Thy-mo-trol system leads to simplified machine design, reduced space requirements, and a saving in time over more complex methods of obtaining a wide speed range.

Normally consisting of three separate units—a small control station, a transformer, and a thyratron tube panel—the control is the first to provide in one equipment the means for electronically starting, stopping, accelerating, and regulating the speed of a motor. Standard units will cover motor sizes up to 5 horsepower, 230 volts.

The Thy-mo-trol system provides wide-range speed control without the use of motor-generator sets or gear and pulley arrangements. A single-dial control, mounted in a heavy-duty push-button station, covers the complete speed range of the motor, both above and below basic speed. The motor is automatically accelerated to preset speed quickly and smoothly without excessive current peaks. The same single dial can also be used to change speed to any desired value during operation.

Thy-mo-trol equipment can be provided for reversing service by the addition of a standard magnetic reversing switch. It can also be furnished with dynamic braking.

In operation, the change from alternating to direct current for the motor field and armature circuits is accomplished by two pairs of thyratron tubes. The control compensates for changes in armature-voltage-drop, holding motor speed constant regardless of normal-load and line-voltage variations.

The stepless speed control increases armature voltage up to basic speed and weakens the field at speeds above basic. Acceleration is automatic. Full field is held until basic speed is reached and is also automatically applied during dynamic braking.

A thermal overload relay protects the motor on sustained overloads. Fuses provide d-c short-circuit protection.

Thy-mo-trol equipment is compact and easily mounted. The control station may be located accessible to the operator, thus allowing complete control of a machine from one location. The thyratron tube panel can be furnished in various types of enclosing cases, such as those for corrosive or dusty atmospheres.

USS Kearny a Cochrane Ship

The USS Kearny, damaged by a torpedo 350 miles south and west of Iceland on October 17, was launched last year by Federal Shipbuilding & Drydock Co. and is one of twenty-four 1,630-ton destroyers known in the service as the Mayo type. The Kearny and ten of her sister ships are equipped with Cochrane marine deaerators of atomizing design for heating the boiler feed to steam temperature and for removing dissolved oxygen as a precaution against boiler-tube corrosion.

Ships of this class are turbine-driven with oil fired boilers. The Navy Department's original announcement did not indicate the specific damage but pointed out that the damage might cause the destroyer to reduce her speed in making port for the necessary repairs. Eleven persons lost and ten injured were reported. Normal complement on a ship of this type is 200 officers and men.

• BUSINESS CHANGES

Downingtown Enters Heat Transfer Field

Downingtown Iron Works of Downingtown, Pa., near Philadelphia, known for many years for high quality fabrication of steel and alloy plate into tanks and other equipment for the process industries, have recently set up a separate division for the manufacture and design of heaters, coolers and condensers.

This Heat Transfer Division is being housed in its own building and is under the direct supervision of men having long practical and technical experience in the design and fabrication of heat exchangers.

Manager of the new division is Mr. R. M. Armstrong, who is in charge of design and sales of the new products. Assisting is Mr. F. J. O'Sullivan. Downingtown's consulting

metallurgist, Dr. T. H. Nelson will collaborate on problems involving unusual metallurgical problems.

Products of the new division will include: storage water heaters, instantaneous heaters, freon water coolers and condensers, large drinking water coolers, large suction line heat exchangers for refrigeration.

Literature describing the general line of products being built is available from the company.

Foote Bros. Appointment

Wallace F. Ardussi has been placed in charge of Research and Product Development for Foote Bros. Gear and Machine Corp., 5298 South Western Blvd., Chicago, Ill., it was announced recently by W. A. Barr, President and General Manager.

Mr. Ardussi has been associated with the Automotive Industry since his graduation in 1928 from the Engineering College of the University of Michigan.

He enters the Foote Bros. organization with a background of ten years engineering experience with Chrysler Corporation where he progressed through the position of Research and Development Engineer, Manufacturing and Production Research Engineering, Assistant to the President of Chrysler Corporation; and Sales Manager of the Airtemp Division of Chrysler Corp.

Fairbanks, Morse & Co. to Build New Diesel Engine Plant

Announcement has just come from the office of Colonel Robert H. Morse, President and General Manager of Fairbanks, Morse & Co. that a "letter of intent" had been issued by Secretary of the Navy, Frank Knox of Washington, authorizing the expenditure of $5\frac{1}{2}$ million dollars for a new building and additional equipment and machinery at the Beloit, Wisconsin, works of the company.

The purpose of this new plant is to triple the production of Fairbanks-Morse Diesel engines for the United States Navy—engines which at the present time are providing both propulsion and auxiliary power for U. S. Navy submarines, cruisers, destroyers, aircraft carriers and other sea power.

Terms of agreement between the Navy Department and the company call for completion of the huge plant, the installation of the machinery and equipment, and a large scale production of Marine Diesels in about a year's time.

In addition to the men required for the construction work and installation of the equipment, the project will mean the addition, in the near future of at least 1200 to 1500 more factory employees to the company's present payroll. At the present time approximately 4500 men are working in the Beloit Plant.

The new structure will have a length of about 660 feet and a depth of 460 feet, with a total floor space of more than 300,000 square feet.

Contained in the new building will be a large machine shop, welding shop, storage facilities for raw and processed materials, assembly floor, erecting floor, test floor, painting and shipping departments, first aid hospital, conference rooms and offices, and suitable provision for production and planning departments and engineers.

The building will be of concrete, brick and steel construction and its design and arrangement will conform to the latest engineering and production practices.

The entire building and its machinery will be devoted to the manufacture of Fairbanks-Morse Diesel engines for the United States Navy.

Colonel Morse said, "Fairbanks, Morse & Co. has been one of the nation's biggest suppliers of primary and auxiliary propulsion equipment to the Navy and these products have been notably successful in meeting all the Navy's exacting requirements of performance and reliability."

Bailey Meter Company Appoints New Branch Manager

Bailey Meter Co., 1026 Ivanhoe Road, Cleveland, Ohio announces the appointment of R. M. Cundiff as manager of its Cincinnati Branch Office at 2512 Carew Tower Building. He succeeds Mr. E. R. Dearborn, former manager whose resignation became effective August 1.

Mr. Cundiff who is a mechanical engineering graduate of the University of Kentucky and a native of that state has for the past twelve years been located in the company's New York Branch Office where he has devoted his efforts to the application of metering and control equipment to steam power plants and industrial processes.

He will be ably assisted in his new position by Messrs. J. A. Lucas and J. E. Zimmerman, both mechanical engineering graduates especially trained in methods of improving boiler plant operation through the application of meters and automatic control.

Robert J. Howison Appointed Automotive Sales Manager

Detroit, Mich., Nov.—Frank M. Hawley, Vice-President of the Morse Chain Co., announces the appointment of Robt. J. Howison as Sales Manager of the Automotive Division, Morse Chain Co., Detroit.

To his new position, Mr. Howison brings a background of more than 20 years association in the silent and roller chain industry. Mr. Howison has been prominently active in the sales, sales engineering and application of timing chains for internal combustion engines, as well as general industrial silent and roller chain applications.

Mr. Howison's appointment, constitutes an expansion of personnel in order to render greater service to the automotive industry.

Hawkinson Elected Allis-Chalmers Secretary-Treasurer

Walter E. Hawkinson, treasurer of the Allis-Chalmers Mfg. Co., Milwaukee, Wis., since 1936, was elected to the joint position of secretary-treasurer on Oct. 2. He assumes the secretarial duties of Wm. A. Thompson, company vice-president and secretary, who resigned recently.

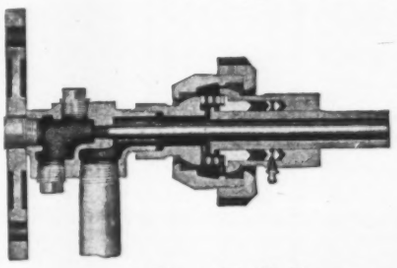
The new secretary started with Allis-Chalmers 34 years ago in the treasurer's department. In the various positions he occupied since, he gained a wide knowledge of finance and management. In 1926 he became assistant manager of the Tractor Division, after which he played an important role in the rapid expansion of the company's agricultural trade. Returning to the treasurer's department in 1936, Mr. Hawkinson was elected its head, a position he will now occupy jointly with his new office as secretary.

Mr. Thompson's resignation terminates forty years of service at Allis-Chalmers. Beginning as a general bookkeeper in the Accounting Department of the company, he

Continued on Page 20

BARCO REVOLVING JOINTS

Prove Their Efficiency Through Lower Power Costs



Type 7R-8CR with Adapter 18R

Two Ball Seats *provide* Flexibility, Eliminating Strain on the Revolving Sleeve

Heat or Cool Rotating Rolls at Lowest Maintenance Costs

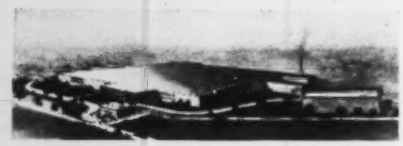
BARCO MANUFACTURING CO.
NOT INC.
1807 Winnemac Ave., CHICAGO, ILL.
In Canada—The Holden Co. Ltd.

Write for Catalog

was later appointed chief accountant. In 1907 he was elected comptroller and in 1923 he was made secretary in addition. He relinquished the office of secretary when he was made a vice-president in 1932, but again assumed the duties of secretary in 1936, retaining this office with the position of vice-president until his recent resignation.

New Allis-Chalmers Supercharger Plant

Milwaukee, Wisconsin, October 16, 1941—In anticipation of receiving final confirming orders from Washington within the next few days, crews began clearing ground here today for the new $9,066,000 supercharger plant of the Allis-Chalmers Mfg. Co. Its completion in about six months will give Milwaukee its first real blackout factory.



Soon after that the 500 x 800 foot single floor building in suburban Greenfield township will be ready to house modern speed-up production facilities for turning out the urgently needed mechanism that, along with the U. S. bomb-sight, has been described as potentially one of the most decisive weapons of the war. It is estimated that when completed a force of approximately 3000 men and women, mostly from greater Milwaukee's own highly industrialized labor supply, will man the streamlined, windowless plant working on night and day shifts.

Built entirely around planned production operations, the new factory will be of purely functional design. According to Carl E. Meyer, head of the Allis-Chalmers architectural staff, the single purpose of production for immediate defense needs has been constantly kept in mind.

Most modern provisions, however, will not only contribute to production efficiency, but provide ideal working conditions as well. Modern air-conditioning, for example, will furnish controlled temperature and humidity throughout. Four refrigerating units having a combined capacity of 2650 tons each day will cool the equivalent of a three inch layer of ice covering the factory's entire floor area.

In the large test rooms, where all finished materials will undergo strictest examination, complete acoustical control will be provided, while the entire building will be specially insulated. Other facilities will include a fully equipped laboratory for research and testing of raw materials plus modern shower and locker rooms.

Only the 50 x 200 foot area devoted to offices and rest rooms will have windows. Fluorescent lighting for the entire area given to production will allow normal operation of the plant through any air raid attacks that may ever affect this inland location. Additional protection against such military eventualities results from location of vital power lines underground, the electrical sub-station to be completely enclosed and protected against the effect of possible bombing.

Adjacent to the main building will be a forge plant, 80 x 200 feet, as well as a terminal building already constructed. Through the latter all materials and manufacturing activities will be routed.

In all respects except supervisory, the new Allis-Chalmers unit will be independent of the operations of its parent plant nearby, now busily engaged in producing nearly $100,000,000 in defense materials. To this list of defense-important capital goods, Allis-Chalmers in a few months will add the turbo-supercharger—the remarkable device that cheats nature . . . enables a giant bomber to climb miles above the earth, actually travelling at higher speeds at more miles per gallon than near the earth's surface.

G-E Turbine Division Changes

Consolidation of the Mechanical Drive and Turbine-generator Sections at General Electric's Lynn River Works has been announced by C. S. Coggeshall, manager of the company's Turbine Division. J. L. Kerr is named manager of sales of the consolidated Lynn section, with L. D. Whitescarver, formerly a turbine specialist in the company's Atlantic District, as general assistant.

All of the company's business in land and marine turbines rated at 7500 kilowatts and less will be handled through the Lynn section, as well as mechanical drive turbines and generator sets of 400 kilowatts and less.

Since January, 1938 Mr. Kerr has been manager of sales of turbine-generators manufactured at the G-E Lynn River Works. He has been with the company since 1913 when he entered the Testing department. His experience in turbine sales work began in 1917, and for a ten-year period beginning in 1928 he was a turbine specialist in the central district. He was graduated from the University of Tennessee, class of 1912, with the degree of Bachelor of Science in Electrical Engineering.

Mr. Whitescarver was employed intermittently in the company's Testing department for four years while he was attending Antioch College, and after his graduation in 1930 with the degree of Bachelor of Arts in Electrical Engineering, was assigned to the Turbine Division at Lynn. He had been a turbine specialist in the Atlantic District since November 1939.

J. R. Casey, of the Turbine Division at Schenectady, has been appointed to Mr. Whitescarver's post in the field. Mr. Casey entered the company's Testing department following his graduation from Worcester Polytechnic Institute in 1937 with the degree of Bachelor of Science in Electrical Engineering.

Denison Engineering to Build New Factory

Announcement has just been made by Mr. W. C. Denison, Jr., president of The Denison Engineering Co., 119 West Chestnut Street, Columbus, Ohio, of the purchase of a 26-acre plot of land on the northwest outskirts of town on which will be erected a new plant, construction of which will be started in two weeks. It is expected to have this new plant ready for production in 60–90 days.

While it will provide about 50,000 square feet of floor space, the company expects to continue the operation of its present plants at 119 West Chestnut Street, 302 North Ludlow Street, and 548 West Broad Street. Mr. Denison further states that with the additional space the company will employ approximately 300 more people.

When Machine Tools
CHATTER
. . . or Bearings and Gears run
HOT.-
use
"STURACO"
EXTREME PRESSURE ("EP")
MACHINERY
OILS & GREASES

STICKING ways resulting from overloads means troublesome "chatter." A STURACO ("EP") LUBRICANT will often eliminate the trouble for it has a technically accepted load carrying capacity of over 300% more than ordinary lubricants.

Hot spindle bearings and gear heads can frequently be cooled to operating efficiency when the proper STURACO ("EP") LUBRICANT is applied.

Results from this unusual principle of lubrication have been astonishing. What is your tough problem? Write, wire or phone today!

SEND FOR the new 20 page booklet outlining laboratory research behind this genuine development.

Stuart Oil Products

FOR ALL LUBRICATION PROBLEMS
D. A. STUART OIL CO.
Chicago, U.S.A. • LIMITED • Est. 1865
Warehouses in All Principal Metal Working Centers

• Keep Informed . . .

The Denison Engineering Co. is now producing defense equipment on direct Government contracts. This equipment includes shell-loading presses, testing equipment for airplane spark plugs, oil hydraulic systems, crankshafts, brakes, gun recoil and presses for assembling gas shells. In addition to orders the company is now turning out for the Government, it also manufactures oil hydraulic equipment, hydraulic pumps, valves, cylinders, presses, fluid motors, and special hydraulic and mechanical machinery.

Changes in Yarway Sales Force

Yarnall-Waring Co., Philadelphia, announces the following personnel changes in their sales organization: C. Wilson, Jr., formerly of the New York office, has been appointed district manager of Pittsburgh-Cleveland territory and C. N. Maxfield, district manager of Detroit territory, covering Michigan and western Ohio. Bernard R. Bristol and Charles H. Grosjean have joined the New York sales staff; A. E. Robinson, the Chicago sales office and A. L. Aicher, for years a member of the factory engineering staff, the Philadelphia sales office.

Johns-Manville Building New Mill

An asbestos mill capable of processing large quantities of asbestos-bearing rock is now under construction on the Johns-Manville properties in Chrysotile, Arizona. According to C. H. Shoemaker, vice president of Johns-Manville Products Corp., the new mill will be in operation early in 1942, and will at that time add substantially to the supply of asbestos fibre available in this country to meet defense manufacturing needs.

The asbestos fibre found at Chrysotile is particularly valuable in the manufacture of filters, woven asbestos materials, asbestos paper, many types of asbestos-cement products, and as fillers in asphalt tile and moulding compounds. The recent development of a special milling process by Johns-Manville engineers has made possible the utilization of this Arizona fibre, heretofore a marginal operation.

Continuous experimentation at J-M's research laboratories in Manville, N. J., resulted recently in the construction of a complete pilot mill with an entirely new process, which will allow the fullest use of Arizona's valuable asbestos deposits. Based on this development a large mill is now being built at Chrysotile, while explorations and tests are going on preparatory to expanding the mine itself.

It has been estimated that approximately 100 men will be employed in the mill and mine, and that this number will be increased as the property is developed, making the Johns-Manville operation at Chrysotile, Arizona's largest asbestos development.

• LATEST CATALOGS

Ampco Distributes New Bulletins

"Ampco Metal Centrifugal Castings" and "Ampco Metal in Bushings and Bearings" are two new bulletins issued by Ampco Metal, Inc., 1745 So. 38th St., Milwaukee, Wis., producers of alloys of the aluminum bronze class.

Each bulletin is letter-head size, six pages in length, and well-illustrated.

"Ampco Metal Centrifugal Castings" describes the process of casting by this method and lists the benefits the customers derive through the use of this method of casting. Centrifugally cast parts are illustrated, as well as a number of views of metal being produced by the centrifugal method.

"Ampco Metal in Bushings and Bearings" contains a discussion of the advantages of using these parts made from Ampco Metal. Case histories are cited to point out the merits of the bronze in actual service. Illustrations of typical parts are included.

Copies of these bulletins will be sent to those interested in the subjects discussed.

Link-Belt Speeder Shovel

A new 4-page Folder No. 1914 illustrating and describing its 1/2-yard Model LS-50 crawler shovel-dragline-crane, has just been published by Link-Belt Speeder Corp., 301 West Pershing Road, Chicago.

The folder particularly covers some of the new design features of this excavator, such as the machine's non-clogging crawler treads; alloy-steel, all-welded lower frame; and the simplified design of the upper machinery. Clearances, dimensions, lifting capacities, and brief specifications, are given.

A copy of Folder 1914 will be sent to any interested reader on request.

Steel-Cutting Carbide Tools

Catalog No. 42, covering specifications and prices of standard Kennametal steel-cutting carbide tools and blanks, has just been issued by McKenna Metals Co., 367 Lloyd Ave., Latrobe, Pa.

The new catalog is believed to be the most complete carbide tool catalog and manual published to date. Typical applications of each style of tool are illustrated by line drawings, and photographs and information on specific examples of the use of Kennametal have been included. Several pages are devoted to selection and design of tools and blanks, correct grinding procedure, chip breaker designs, brazing tool blanks to shanks, boring tool set-ups, and other pertinent engineering data. The new Kennametal round shank boring tools, cut-off tools, roller type turning tools, and solid round tools are illustrated and described.

Copies of the new Kennametal Catalog No. 42 will be furnished on request.

Monthly News Digest Announced by Graham Transmissions

To help solve the problem of keeping up with the news when reading time is short, Graham Transmissions, Inc., are issuing a monthly digest of current technical news for industrial executives. Known as the "Graham Dial", the publication contains a brief abstract of outstanding articles in the technical press. Articles presented are chiefly from original engineering sources so that the information is fresh and authentic; subject matter is "boiled down" to just the essential facts, with the source given in full so that the interested reader may readily refer to the complete article. Included are brief articles on Metallic Traction and the Graham Variable Speed Transmission.

Engineers and industrial executives may receive the "Graham Dial" without charge; copies may be obtained by writing to MECHANICAL ENGINEERING or directly to Graham Transmissions, Inc., 2711 North 13th St., Milwaukee, Wis.

Continued on Page 22

Permanently Smooth Close Control

OHMITE RHEOSTATS

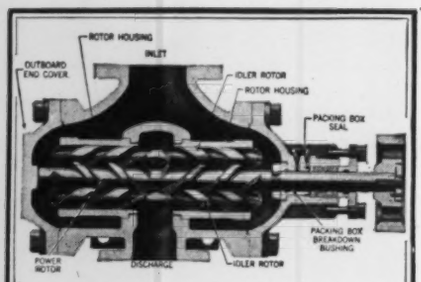
IT'S the way Ohmite Rheostats are designed and built that insures the smooth, dependable, trouble-free control so essential today in Industrial and Defense applications. You'll find them controlling speed, heat, light and air in products, laboratory and production equipment . . . you'll find them in airplanes, ships, tanks, and submarines.

The wide range of types and sizes provides the exact unit for each need. There are ten wattage sizes, in standard or special designs from 25 watts to 1000 watts, from 1 9/16" to 12" diameter. Many stock resistance values. Special variations produced to your specifications or engineered for you.

Write on company letterhead for 96-page Catalog and Engineering Manual No. 40.

OHMITE MANUFACTURING CO.
4809 Flournoy Street, Chicago, U.S.A.

OHMITE
RHEOSTATS RESISTORS TAP SWITCHES



ESSENTIALS

The De Laval-IMO Oil Pump

1—*runs* at motor or turbine speeds,
2—*delivers* any oil in any volume against any pressure,
3—*occupies* small space, and
4—*uses* power efficiently.

But DOES NOT

a — have valves, gears, separate bearings or oscillating parts,
b — set up pulsation or vibration,
c — have high-pressure packing boxes, or
d — require disconnection of piping or disturbance of motor for internal inspection.

Ask for Catalog I-84.

IMO — I MOVE OIL

IMO PUMP DIVISION
of the
DeLaval Steam Turbine Co.
Trenton, New Jersey

PROFESSIONAL SERVICE

In ALL BRANCHES
of the ENGINEERING FIELD

Consulting Engineers
Engineering Organizations
Constructors—Contractors
Patent Lawyers, Etc.

Power Plants and Electrical Distribution for Industry. Surveys, Reports, Design, Construction, Supervision.
EDWARD R. FEICHT
Bala-Cynwyd, Pa. (outside Philadelphia)

Chemical and Metallographical Laboratories—Welding . . . Supervision, Inspection and Testing, Qualification of Operators and Procedures.
THE JAMES H. HERRON CO., Cleveland, Ohio

Weld Testing—Qualification of Operators—Supervision—Inspection—Research.
NATIONAL WELD TESTING BUREAU
Pittsburgh Testing Laboratory, Pittsburgh, Pa.

Power Plants, Structures Transmission Systems—Design Supervision, Inspection, Appraisals Reports.
SARGENT & LUNDY
140 S. Dearborn St., Chicago, Ill.

RATE Announcements under this heading in MECHANICAL ENGINEERING are inserted at the flat rate of $1.25 a line per issue, $1.00 a line to A.S.M.E. members, minimum charge, three line basis. Uniform style set-up. Copy must be in hand not later than the 10th of the month preceding date of publication.

• Keep Informed . . .

Fabrication of Clad-Steel Plate

The International Nickel Co., 67 Wall St., New York, N. Y., announces a Revised Edition of Technical Bulletin T-4, entitled "Methods for the Fabrication of Clad-Steel Plate."

This bulletin has been revised in accordance with the latest field practice.

The information contained therein describes strength and permanence of bond, mechanical properties, standards of cladding, and sizes and finishes.

Instructions are given for cold working, hot working, annealing, design, fabrication, arc welding and surface cleaning.

Haering Publishes New Edition of "Organic Methods"

A new fourth edition of the D. W. Haering & Co. Booklet on "Organic Methods of Scale and Corrosion Control," America's only text on the use of organic chemicals in water treating is just off the press. Largely rewritten and enlarged to accomodate additional information, this new twenty-eight page discussion of organic methods presents the newest information on scale and corrosion control.

Celebrating their tenth anniversary of scientific contributions to scale and corrosion control the Haering Organization has incorporated a number of charts, graphs, tables and half tones to illustrate the usefulness of organic chemicals in water conditioning and point the way to substituting these efficient and available chemicals for products which are now obtainable with difficulty, if at all.

In addition to the discussion of organic chemicals the new edition includes an explanation of causes of scale and corrosion and introduces a new section tabulating the physical and chemical properties of the various glucosates developed by Haering Research.

Several pages are devoted to analytical and control test procedures for determining the glucosates and the entire booklet provides a comprehensive discussion of the history, principles, chemistry and control of Organic Methods of Scale and Corrosion Control.

The fourth edition of "Organic Methods of Scale and Corrosion Control" is available without charge or obligation to those addressing requests to D. W. Haering & Co., Inc., 205 W. Wacker Drive, Chicago on business letterheads.

Principles of Metallic Traction Set Forth in New Graham Manual

Principles of metallic traction, with explanatory curves and diagrams, are set forth for the first time in manual #501 just released by Graham Transmissions, Inc. Included is a description of the reversing feature, available on some Graham variable speed transmissions, which delivers equal speeds forward or reverse (both sides of zero) without stopping or reversing the motor. The manual also summarizes the applications of various types of variable speed transmissions, and states when and when not to use a unit of the Graham type.

Complete data on Graham variable speed transmissions is given in the manual, together with illustrations and notes on typical installations. Illustrated and described in detail are such Graham features as the ability to deliver full torque over the entire speed range from maximum to zero, ability to hold selected speeds closely without cyclic variation and to obtain pre-selected speeds accurately on reset. The reversing feature above described is of special value in applications to sighting, aiming and steering devices.

In addition to the three sizes of Graham units now available, $1/8$ to $1\,1/2$ h.p., a fourth unit for 3 h.p. drive will soon be in production. These sizes are offered in standard, geared reduction and geared step-up types for either built-in or coupled motor mounting.

Copies of Manual #501 may be obtained by writing MECHANICAL ENGINEERING or directly to Graham Transmissions, Inc., 2711 N. 13th St., Milwaukee, Wis.

Foster Automatic Valves

Foster Engineering Co., 107 Monroe St., Newark, N. J., announces their latest Catalog No. 70 featuring their Reducing Valves, Temperature Regulators, Pump Governors, Relief Valves, Back Pressure Valves, etc. Fully describes each type including assembly, disassembly, operation, application and installation. Gives dimensions and weights.

Also included is engineering data—on the selection of Steam Pressure Regulators; on Capacities of Pressure Regulators for Steam, for Gases, and for Water; on Effect of Reducing Valves on Steam Condition; Foster Steam Flow Chart, etc.

A neatly bound Catalog with spiral binding, sectionalized and well-indexed with a resumé of other Foster Automatic Valves.

A copy of this Catalog will be sent executives and engineers engaged in those industries serving national defense and if the request is written on the company's letterhead.

COMING MEETINGS AND EXPOSITIONS

For the next three months

DECEMBER

1–5	The American Society of Mechanical Engineers, Annual Meeting, Hotel Astor, New York
1–3	American Society of Agricultural Engineers, Fall Meeting, Stevens Hotel, Chicago, Ill.
3–6	American Society of Refrigerating Engineers, Annual Meeting, St. Louis, Mo.
4–5	Society for the Advancement of Management, Annual Conference, Hotel Commodore, New York
29–Jan. 3	American Association for the Advancement of Science, Winter Meeting, Hotels Adolphus and Baker, Dallas, Texas

JANUARY

12–16	Society of Automotive Engineers, Annual Meeting, Book Cadillac Hotel, Detroit, Mich.
21–23	American Society of Civil Engineers, Hotel Waldorf-Astoria, New York
26–30	American Institute of Electrical Engineers, Winter Convention, Engineering Societies Building, New York
26–30	American Society of Heating and Ventilating Engineers, 48th Annual Meeting, Bellevue-Stratford Hotel, Philadelphia, Pa. and Seventh International Heating and Ventilating Exposition
28–30	Institute of Aeronautical Sciences, 10th Annual Meeting, Waldorf-Astoria Hotel and Columbia University, New York

FEBRUARY

5–6	Engineering Institute of Canada, Annual General and General Professional Meetings, Windsor Hotel, Montreal, Canada
9–12	American Institute of Mining and Metallurgical Engineers, Annual Meeting, Engineering Societies Building, New York
16–19	Technical Association of Pulp and Paper Industry, Annual Meeting, Hotel Commodore, New York.

For Calendar of Coming A.S.M.E. Meetings see page 927 in the editorial section

DISSTON meets tough feedwater problem with COCHRANE Deaerating Softener

New boiler house of Henry Disston & Sons, Inc., H. M. Wilson Co., Engineers & Constructors, Philadelphia.

View showing, above, the oil removal filter and two Cochrane-treated Water Filters and Sedimentation Tank of Cochrane Deaerating Hot Process Softener. Laboratory table in foreground.

AT the plant of Henry Disston & Sons, Inc., in Philadelphia, the normal power needs of this century-old manufacturer of saws, tools, files, knives and steel, plus the enormous defense load it has recently taken on, are amply provided for in the new high-pressure boiler plant just completed, in which a Cochrane Deaerating Softener and a Cochrane Continuous Blow-Off System are a part of the ultra-modern equipment.

The raw boiler water is river water with a hardness of 40 to 50 parts per million. It enters the softener at 60°F. from the heat exchanger of the Cochrane Continuous Blow-Off System and is treated with phosphate, the feeding of which is automatically controlled by a Cochrane Flow Meter. The treated make-up is deaerated by atomization in the softener. Condensate, after passing through a Cochrane Oil Removal Filter, is deaerated separately in the softener and joins the treated raw water at the feed pump. Heat from the boiler blow-off is recovered by a Cochrane Continuous Blow-Off System.

★ Many unique applications of feedwater treatment together with a discussion of Boiler Feedwater Analyses and Their Interpretation are included in Cochrane's handbook on Hot Process Softening, a copy of which will be mailed on receipt of coupon below.

COCHRANE CORPORATION • 3123 N. 17th ST., PHILADELPHIA, PA.

Cochrane

SOFTENERS • DEAERATORS • FLOW METERS • STEAM SPECIALTIES

Cochrane Corporation
3123 N. 17th St., Philadelphia, Pa.

Please send me a copy of Cochrane Publication 3000 (Hot Process Softening).

Name _____

Firm _____

Address _____

City _____ State _____

THE CONTINUOUS LINK

between the Present and the FUTURE

Future plant operation will be on a different basis . . after these billion dollar days and their priorities are gone. And, of course, many *new* men will be in the industrial picture.

Who will they be? We believe they will be the young technically trained men.

Those embryo engineers will go on, and up, faster than ever. And those of them who are well informed on the broader and deeper economic phases of engineering and industry will go up *fastest*.

Helping them to become so informed, and prepared, is the job industry and the engineers of today have undertaken to do through The American Society of Mechanical Engineers.

It is a group effort. Over 7000 potential engineers are being helped. They can be reached, as *a group*, only through MECHANICAL ENGINEERING.

But you will reach *more* than these embryo engineers. You will also have the means of effective contact with some 16,000 other engineers and industrial executives, many of whom occupy TOP positions, and many of whom are on the way to the top.

Thus, you have in MECHANICAL ENGINEERING, a continuous link between the present and the FUTURE . . forged out of the far-reaching cooperative activities carried on through the A.S.M.E.

* * *

MECHANICAL ENGINEERING should be on your advertising schedule for 1942.

DEFY ERASURE-GHOSTS
with this new tracing cloth

Here is a tracing cloth that holds erasure scars at a minimum—that won't show water marks or perspiration stains. Now you can have clean tracings, in pencil or ink, free from these untidy "ghosts" that reproduce on blueprints!

For PHOENIX is ghost-proofed by a remarkable new process that defies moisture and gives you an unusually durable working surface. You can use harder pencils with this improved cloth and get sharper lines with less tendency to smudge. Even 6H lines show clearly, and reproduce sharply! Erasing does not mar the drawing surface; erased areas take pencil smoothly—and ink without feathering. Its new white color and increased transparency give you excellent drawing contrast and produce strong blueprints.

Let PHOENIX prove its virtues on your own drawing board. See your K&E dealer, or write for a generous working sample and an illustrated brochure.

EST. 1867
KEUFFEL & ESSER CO.
NEW YORK · HOBOKEN, N. J.
CHICAGO · ST. LOUIS · SAN FRANCISCO · LOS ANGELES · DETROIT · MONTREAL

PHOENIX DEFIES MOISTURE GHOSTS

Perspiration and water splashes on ordinary tracing cloth create "ghosts" which reproduce on blueprints. PHOENIX Tracing Cloth withstands actual immersion in water for fully 10 minutes at a time! *Perspiration and water marks will not stain it!*

PHOENIX LESSENS SMUDGE GHOSTS

The new improved surface of PHOENIX Tracing Cloth permits you to use harder pencils (5H and 6H) and to get sharper lines with less tendency to smudge.

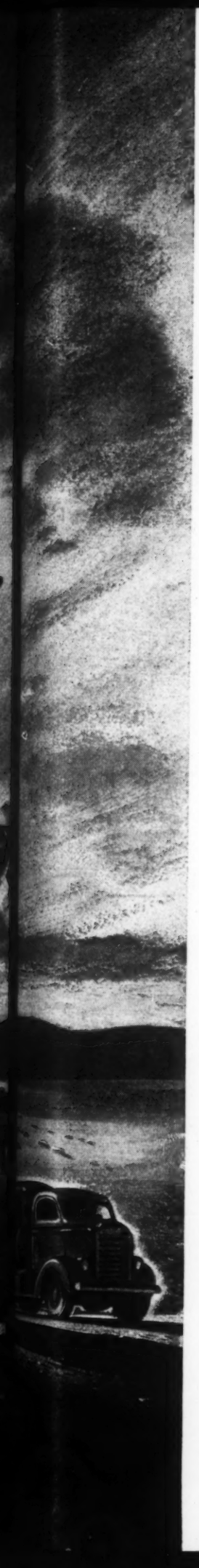
Result: Cleaner tracings and blueprints.

PHOENIX REDUCES ERASURE GHOSTS

Ordinary tracing cloths become scarred when erased... erased spots produce ghosts on blueprints.

PHOENIX has a durable drawing surface that reduces working scars to a minimum.

K&E
Phoenix
REG. U.S. PAT. OFF.
TRACING CLOTH
for pencil *and* ink



THE "GASOLINE AGE" IS JUST BEGINNING

WE STAND on the threshold of the real age of gasoline power.

Despite the great progress which has been made thus far in the development of automotive fuels and engines, only a fraction of the energy in gasoline is being utilized. The greatest significance of the developments which have been made to date lies in their value as part of the foundation for the far greater progress of the future.

In the establishment of this foundation for future progress, not only the actual technical results but also the manner of their achievement are of great importance. Fuel problems and engine problems once were regarded as things apart, and they were handled accordingly. Today, it is realized that the entire automotive unit with its fuel and lubricants must be considered together. The result is that research on the development of fuels, engines and lubricants is coordinated to be of maximum benefit to automotive transportation as a whole.

From the standpoint of the engine builder this coordinated development involves exploring the application of supercharging and super-compression ratios to engines, for utilizing the high octane fuels which will be produced by combining the products of new refining processes with anti-knock additives. An essential part of the study of super-compression and supercharging is the investigation of related engine design changes which may be necessary.

Because of the close relation of engine and fuel characteristics and engine operating conditions, design changes in such vehicle parts as inlet manifolds or transmissions may have important effects on fuel utilization, and they should be considered from this standpoint.

We of the Ethyl Gasoline Corporation have built up a wide experience in laboratory and field studies in which fuels and engines must be considered together, and our facilities are especially designed for such work. Our research and service workers welcome opportunities to cooperate in extending the usefulness and efficiency of automotive transportation through the mutual development of fuels and engines, thus expanding the benefits of the "gasoline age."

ETHYL GASOLINE CORPORATION

Chrysler Building, New York, N. Y.

WITH

ETHYL

ETHYL GASOLINE CORPORATION

When preparing your...

CHRISTMAS GIFT LIST

do remember that many of the A.S.M.E. Publications make ideal gifts. *For instance...*

MECHANICAL ENGINEERING

is recognized as one of the foremost technical magazines in the country. Isn't there at least one friend or business associate on your list who would welcome receiving the next twelve issues? The subscription price is nominal—only $5.00 annually; $4.00 to A.S.M.E. members.

MANUAL ON CUTTING OF METALS

This book is useful to production-executives, shop foremen, machine designers, and rate setters. The data in its 330 pages are presented in the form of tables from which speeds and feeds for the metals in common use can be set for various depths of cut. Time and horsepower necessary for a cut under the stated conditions are shown and examples in the use of the tables are given; also general and mathematical data on the theory of cutting metals.

Cloth Binding. Price $5.00; $4.00 to A.S.M.E. members.

A Set of Standards on SMALL TOOLS AND MACHINE TOOL ELEMENTS

is a valuable addition to any engineer's library. In this collection are 23 Standards dealing with sizes, capacities, and clearances of machine tools and of other work and tool holding parts; length of stroke, travel, and other movements and adjustments; parts and elements for holding and adjusting, guiding or aligning work or tools, including bolts and nuts, slots, bushings and tapers, drills, taps, reamers, cutters, countersinks, chucks and jigs. The price, including a binder for holding the pamphlets, is $10.85; $9.77 to A.S.M.E. members.

On PIPING AND PIPE FITTINGS

the Society has published 16 Standards presenting tables of approved dimensions and designation of materials for pipe, pipe plugs, pipe flanges and fittings of 25, 125, 250, and 800 lbs. pressures; brass, screwed, sprinkler, soldered-joint, and butt-welding fittings. Also included are face-to-face dimensions of ferrous flanged and welding end valves.

The price, including a binder for holding the pamphlets, is $8.50; $7.65 to A.S.M.E. members.

To the man who constructs or uses boilers and pressure vessels, no gift will be more welcome than the

COMBINED EDITION OF THE A.S.M.E. BOILER CONSTRUCTION CODE

In the eight sections of this Code are the construction and inspection rules covering power, low-pressure heating, miniature, and locomotive boilers; unfired pressure vessels; material specifications; and recommendations for care of boilers in and out of service.

Price $8.50; $6.80 to A.S.M.E. members.

For those interested in hydraulics and fluid mechanics, there are the following handsomely bound reference works:

FLOW OF WATER IN PIPES AND PIPE FITTINGS

This is a record of results of experiments made by John R. Freeman in the nineties to obtain accurate data on flow of water in pipe, friction losses, and artificial roughness. All of the results are presented in such form as to be applicable to the present day problems of designing engineers.

Price $8.00; $6.40 to A.S.M.E. members.

HYDRAULIC STRUCTURES

This is a comprehensive work covering the functional design and detailed analysis of virtually all types of hydraulic structures. In addition to 1172 pages of text, there are 2057 illustrations; 119 tables giving numerical data, values of coefficients, etc.; 675 bibliographical references; and an index.

Published in two volumes. Price $18.00; $14.40 to A.S.M.E. members.

In the following A.S.M.E. Biographies are some extremely interesting stories of the lives of eminent engineers and of the engineering developments with which they were identified.

LIFE OF HENRY LAURENCE GANTT

This is a portrayal of his life's work and creative thinking on industrial matters.

Price $5.00; $4.00 to A.S.M.E. members.

AUTOBIOGRAPHY OF AN ENGINEER

is the life story of William Leroy Emmet, the man who designed and developed the mercury-vapor power system. Interwoven in his story are accounts of the many developments in which he had a leading part.

Price $3.50; $2.80 to A.S.M.E. members.

BIOGRAPHY OF JAMES HARTNESS

His life story is also the story of the developments of the machine shops of New England and of the introduction of management mechanism in industry.

Price $4.00; $3.20 to members.

AUTOBIOGRAPHY OF JOHN A. BRASHEAR

The story of the man who was recognized as one of the most notable makers of optical lenses and surfaces of his day is a fascinating one, revealing a life spent in unselfish persuit of high ideals and tremendous tasks.

Price $5.00; $4.00 to A.S.M.E. members.

BIOGRAPHY OF JOHN STEVENS

is a vivid portrayal of Stevens' career, and of the development of steam navigation and railway construction in this country to which he devoted his life's energy.

Price $5.00; $4.00 to A.S.M.E. members.

BIOGRAPHY OF ROBERT HENRY THURSTON

Dr. Thurston's story is that of a far-visioned leader and educator who set a new standard for all engineering education.

Price $5.00; $4.00 to A.S.M.E. members.

Published by

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

Publication-Sales Department

29 WEST 39th STREET

NEW YORK, N. Y.

You Profit BY INSTALLING CLEVELAND DRIVES

because . .

Clevelands Keep Your Machines Running at Full Capacity *in* Customers' *Plants*

The Mechanical Engineer of a very large Smelter says: —"In 1929, we installed 6 Cleveland Worm Gear Speed Reducers, and as 4 of these were to operate under extra-heavy loads, we purchased oversize equipment.

"Because all 6 proved satisfactory, more Clevelands were ordered when needed."

Actually 50 large Cleveland Worm Gear Units have been installed by this great Corporation since the first installation was made, 16 years ago.

Thirty years' application to the single job of building Worm Gear Speed Reducers, warrants your confidence that Clevelands will keep the equipment *you* build, earning through many years to come.

Insure steady, dependable performance in Customers' Plants by installing Clevelands on your new equipment now. Special information for Machine Builders gladly furnished upon request.

The Cleveland Worm & Gear Company, 3264 East 80th Street, Cleveland, Ohio.

Affiliate: The Farval Corporation, Cleveland, Manufacturers of Centralized Systems of Lubrication

In Canada: PEACOCK BROTHERS LIMITED

CLEVELAND WORM GEAR *Speed Reducers*

The Standards COLUMN

News of Interest to Manufacturers

Supplement to the 1937 Edition, American Standard Safety Code for Elevators

Today, public policy dictates that our efforts and resources be utilized for national defense. To further this policy, the Sectional Committee on a Safety Code for Elevators, Dumbwaiters and Escalators, A17, has prepared a special interium pamphlet in place of a revision of the 1937 edition of this important safety code.

This pamphlet includes errata, interpretations, and a few revisions, all tending toward greater safety with a minimum of expenditure in manhours and material. The 1937 edition of the code, as amended by this supplement, takes the place of the proposed 1941 edition. Copies of this pamphlet may be obtained on application to the A.S.M.E. headquarters office, Price 25 cents.

However, the changes made in the code by the promulgation of this supplement have not, as yet, been incorporated in the American Recommended Practice for the Inspection of Elevators (Inspectors' Manual). A supplement to that publication covering such items is now in preparation.

The committee has already made progress toward the completion of a revised and more clearly worded edition of the American Standard Safety Code for Elevators. It has prepared also drafts of recommendations on existing installations, operation and maintenance procedure, and other associated subjects. There remains, however, much additional work to be done before this material is ready for final approval and adoption. The committee is continuing to give interpretations and will proceed with its other activities so that a fully revised and simplified code will be available after the national emergency has passed.

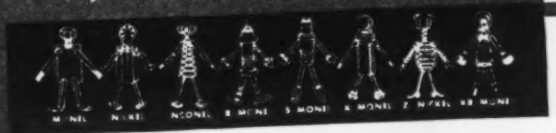
It will be recalled that the first edition of the safety code was completed, approved and published in 1921. This edition was prepared by an A.S.M.E. committee. In November, 1922 this committee was reorganized as Sectional Committee A17 under the procedure of the American Standards Association. The first American Standard Safety Code for Elevators, Dumbwaiters and Escalators was published in 1925. The third and fourth editions appeared in the years 1931 and 1937 respectively.

Research in the performance of under-car safeties, buffers, etc., was organized and supervised by this committee through the medium of an A.S.M.E. Special Research Committee on Elevators. The experimental work was done at the National Bureau of Standards and a total of $90,000 subscribed by industry was expended.

For further information—address

The American Society of Mechanical Engineers
29 West 39th St., New York, N. Y.

8 STRONG, RUSTLESS *Metals*



..each with a DIFFERENT PLUS!

Extra hardness, heat-resistance, non-magnetism, free-cutting and other qualities available in INCO Nickel Alloys

You doubtless know that Monel combines *strength* with excellent *resistance* to *corrosion*. But do you know that newer members of the INCO Nickel Alloy family combine varying degrees of strength with other useful properties? For example:

One of these metals is extra hard and non-galling; two are free-machining, two heat-treatable, one is non-magnetic, one especially adapted for high temperature service, while several make excellent spring materials for use under different conditions.

Knowing the *individual* characteristics of the INCO Nickel Alloys, will better enable you to meet the requirements of defense and other contracts. Write for the booklet, "*Individualized* INCO NICKEL ALLOYS." Address:

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street **New York, N. Y.**

	INDIVIDUALIZED CHARACTERISTICS	AVERAGE MECHANICAL PROPERTIES					
		Condition	Tensile Strength 1000 psi.	Yield Strength 1000 psi.	Elongation in 2 in. per cent	Hardness Brinell 3000 kg.	Impact Strength Izod
MONEL* 2/3 Nickel 1/3 Copper	GENERAL PURPOSE ALLOY Corrosion Resistance, Strength, Hardness, Toughness. Attractive Silvery White Color.	Annealed	75	35	40	125	105
		Hot-rolled	90	50	35	150	110
		Cold-drawn	100	80	25	190	95
		Cold-rolled, hard-temper	110	100	5	240	
"R" MONEL* Contains the addition of 0.05% sulfur.	FREE CUTTING For High Speed Machining.	Hot-rolled	85	45	35	145	96
		Cold-drawn	90	75	25	180	99
"K" MONEL* Contains the addition of 2.75% Aluminum	EXTRA STRENGTH AND HARDNESS comparable to heat treated alloy steel. Heat Treatable. Non-magnetic.	Hot-rolled, As-rolled	100	45	40	160	120+
		Hot-rolled, Heat-treated	150	110	25	280	40
		Cold-drawn, As-drawn	115	85	25	210	56
		Cold-drawn, Heat-treated	155	115	20	290	26
"KR" MONEL*	FREE CUTTING Extra Strength and Hardness. Heat Treatable. Non-magnetic.	Hot-rolled, As-rolled	105	65	40	185	
		Hot-rolled, Heat-treated	150	105	25	280	
		Cold-drawn, As-drawn	115	85	25	215	
		Cold-drawn, Heat-treated	155	115	25	290	
"S" MONEL* Contains the addition of 4% silicon	EXTRA HARDNESS Non-galling.	Sand-cast, Annealed	90	70	3	275	
		Sand-cast, As-cast	130	100	2	320	
		Sand-cast, Heat-treated	130	100	2	350	
NICKEL 99.4% Nickel	CORROSION RESISTANCE Protection for Pure Products. Magnetic below 680° F. Good Electrical Conductivity.	Annealed	70	20	40	100	120+
		Hot-rolled	75	25	40	110	120+
		Cold-drawn	95	70	25	170	120+
		Cold-rolled, hard-temper	105	95	5	210	
"Z" NICKEL* 98% Nickel	EXTRA STRENGTH AND HARDNESS Heat Treatable. Excellent Spring Properties. Good Electrical Conductivity. Magnetic.	Hot-rolled, As-rolled	105	50	35	180	120+
		Hot-rolled, Heat-treated	170	130	15	320	25
		Cold-drawn, As-drawn	120	90	25	220	120+
		Cold-drawn, Heat-treated	175	135	15	340	25
INCONEL* 80% Nickel 14% Chrome Balance—Iron	HEAT RESISTANCE Retains Strength. Resists Oxidation. High Corrosion Resistance.	Annealed	85	35	45	150	120+
		Hot-rolled	100	60	35	180	110
		Cold-drawn	115	90	20	200	85
		Cold-rolled, hard-temper	135	110	5	260	

*"MONEL" and other trade-marks which have an asterisk associated with them are trade-marks of The International Nickel Company, Inc.

INCO NICKEL ALLOYS

MONEL • "K" MONEL • "S" MONEL • "R" MONEL • "KR" MONEL • INCONEL • NICKEL • "Z" NICKEL

Sheet... Strip... Rod... Tubing... Wire... Castings

YOUR A.S.M.E. CATALOG
Your Best Aid for Greater Production

YOUR A.S.M.E. CATALOG AND DIRECTORY is custom made for mechanical engineers. Its catalog pages are from companies who serve the mechanical engineer's needs. Its pages contain only data of interest to mechanical engineers.

Its Directory contains the market source of only mechanical equipment. It is concentrated in one field. Over 3700 firms list an average of 10 products each under over 4000 classifications. No other catalog does that for any technical executive.

In your Catalog there is no mixture of materials and equipment, distinctly belonging to another field.

If you have available other Catalogs, turn your engineering mind loose on these. Analyze these in a parallel form and see for yourself how well your A.S.M.E. Catalog serves the mechanical engineer. See how many references made to such books will produce an answer to your problem in the A.S.M.E. Catalog and not in the others.

Make sure that a mere impression due to bulk or dressing for eye appeal does not influence you in estimating the value of these catalogs.

Both your Society and the A.S.M.E. Catalog serve the engineer and have no interests outside of this one function of service.

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS
29 WEST 39th STREET . . . . NEW YORK, N. Y.

31st YEAR

F-M MOTORS WITH THE COPPERSPUN ROTOR . . .

• *Now* is the time to give your motors a thorough physical examination. Can they be depended upon to stand up under today's greater demands? Find out *before* they fail . . . *before* they cause expensive delays.

Then *compare* your motors with Fairbanks-Morse Motors having the *Copperspun* rotor. These F-M motors set a new standard of performance . . . a standard that's in tune with today's production tempo.

They are unrivaled in ability to stand up under the most severe plugging and reversing service. Why? Because they are the *only* motors having rotors with windings centrifugally cast in one piece of SOLID COPPER.

And the characteristics of copper make it the ideal rotor material. Copper has high electrical and thermal conductivity (twice as good as aluminum), greater strength, and low thermal expansion.

If dependable power is important to your operations, investigate these superior motors now. Write Fairbanks-Morse & Co., Dept. L47, 600 S. Michigan Ave., Chicago, Ill.

Branches and service stations throughout the United States and Canada.

Copperspun
Patented

FAIRBANKS·MORSE MOTORS

DIESEL ENGINES ELECTRICAL MACHINERY RAILROAD EQUIPMENT WASHERS-IRONERS STOKERS
PUMPS FAIRBANKS SCALES WATER SYSTEMS FARM EQUIPMENT AIR CONDITIONERS

swords AND plowshares..

. . . guns *and* bread! Whatever the job, whether for war or peace, Arkwright tracing cloths need make no compromise with quality. Years of testing in Arkwright laboratories . . . years of insistence on highest quality materials and highest standards of manufacture have prepared Arkwright for any national emergency. Today, you can order Arkwright tracing cloths with the same confidence in quality . . . the same assurance of rapid delivery that has given Arkwright its recognized position as America's leading manufacturer of tracing cloth for over twenty years! Arkwright Finishing Company, Providence, R. I.

Arkwright

TRACING CLOTHS

Concerning . . . . A.S.M.E. ACTIVITIES

COMMITTEE ON PUBLICATIONS

Last month this column was devoted to the work of the Committee on Meetings and Program of The American Society of Mechanical Engineers. How the papers presented at Society Meetings under the sponsorship of this committee and other Society agencies that contribute to the technical literature of the mechanical engineering profession are handled under the supervision of the Committee on Publications is to be told in this month's column.

One of the first acts of the Council of The American Society of Mechanical Engineers was the appointment of a Committee on Publications. The earliest committee served only until November, 1880, but during its brief existence it prepared for publication and distributed 1500 copies of the first Catalogue, which later became the "Year Book" and in 1928 the Membership List, which is still published today as one of the activities of the Committee on Publications.

With that first Annual Meeting of 1880 came the presentation of papers worthy of permanent preservation in printed form, and the Committee on Publications therefore undertook the preparation of the Transactions. Up to 1926 the Transactions appeared as an annual volume comprising the papers of most permanent value. At that time the growth of the Society's Professional Divisions had so increased the number of papers available for publication that a new scheme of more frequent publication was put into effect. Up to 1934, therefore, the papers of the several divisions were issued from time to time throughout the year in sections divided as to subject matter in accordance with the special interests of the divisions. In 1934 all sections were combined in a monthly periodical, Transactions, four issues of which were devoted each year to the papers of the Applied Mechanics Division and called "Applied Mechanics Journal." The "Society Record," including indexes, reports, committee personnel, and memorials to deceased members, was issued occasionally as part of the Transactions. During all these years since 1926 the numerous sections of Transactions were, and are today, bound together in an annual volume, thus retaining the permanent feature of earlier issues.

In order to provide advance copies of papers prepared for presentation and for the publication of other Society material "Proceedings" was instituted in 1883. In 1908 this was enlarged as to scope and called the "Journal," and in 1920, after a study had convinced the Society that further improvements and enlargement were indicated, "Mechanical Engineering" became its name.

By 1921 it became evident that Society news should be separated from the technical papers and other general features of Mechanical Engineering, and hence a semi-monthly publication "The A.S.M.E. News" was inaugurated. Business conditions in 1933 forced the amalgamation of the News with "Mechanical Engineering," where it still appears.

As an outgrowth of "Mechanical Engineering" and to meet a need for condensed statements of the products of manufacturers of mechanical engineering equipment, the Committee on Publications instituted an annual volume known today as "A.S.M.E. Mechanical Catalog & Directory."

Other activities under the supervision of the Committee are the publication of codes and standards developed by the Society's technical committees, biographies of eminent members of the Society, and miscellaneous books and pamphlets resulting from work carried on by the Society and its numerous committees.

This extensive publication work of the Society is administered by a committee of five members, one of whom is replaced every year by presidential appointment. Recently, advisory members have been added to the committee. At present there are 5 of these, 3 located in geographically different sections of the country and two drawn from the ranks of junior members.

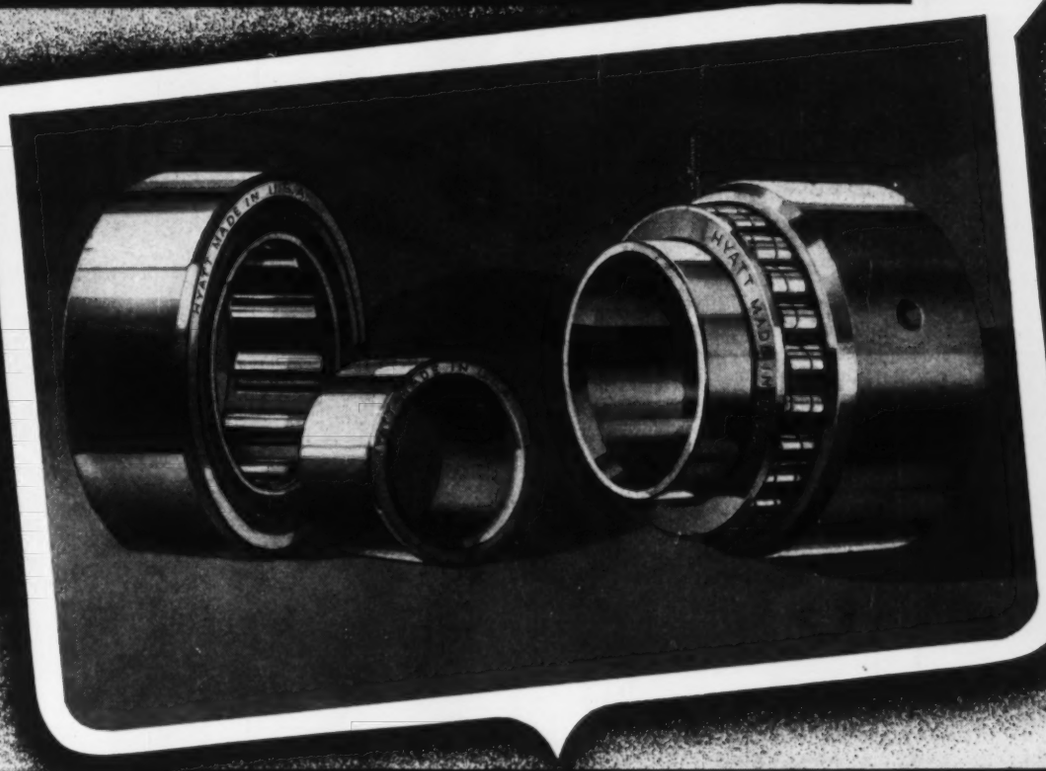
Papers for publication are received by the Committee on Publications, after review and with recommendation to publish, from the numerous divisions and committees with which they originate. From these the Committee on Publications select those it can publish and assigns each paper to "Mechanical Engineering" or Transactions.

In addition to papers officially received in this manner the Committee receives others directly from the Local Sections and from individual contributors. These are reviewed and, if approved by the Committee, are published in "Mechanical Engineering."

For further information—address

The American Society of Mechanical Engineers
29 W. 39th St., New York, N. Y.

KEEP THEM GOING WITH HYATTS

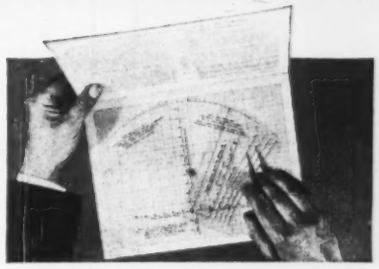


NO MATTER WHAT THE APPLICATION

Precision built... great in capacity... Hyatts are helping to lighten the loads of all mechanized defense equipment.

Meanwhile, Hyatts still are serving in their regular, and now more essential than ever, role of keeping free from bearing wear and care the machinery which produces this defense equipment.

Therefore remember, today as always, that where the loads are heavy and the going is tough you can depend on Hyatt Roller Bearings for any application.



FREE TO MACHINE DESIGNERS

HYATT GEAR THRUST CALCULATOR —valuable timesaver for designers and engineers. Request in writing on your company letterhead — address Sales Promotion Department, Hyatt Bearings Division, General Motors Sales Corporation, Harrison, N. J.

HYATT

ROLLER BEARINGS

QUIET

OBJECTIVES
of the A.S.M.E. Heat Transfer Division

HEAT Transfer as a professional subject cuts across the lines of the Society's organization The objectives of the Division have been summarized in its by-laws as follows:

(1) To constitute a Division interested in the improvement of the design and operation of all classes of heat transfer equipment.

(2) To promote the exchange of information concerning the principles of heat transfer and the supporting data.

(3) To encourage experimental and theoretical investigations of the principles of heat transfer, and to foster improvements in the technique of testing heat transfer equipment to the end that reliable numerical evaluation of these principles may be effected.

(4) To disseminate information on heat transfer; to summarize and publish data on the thermophysical properties of substances, especially those of engineering importance.

These objectives are promoted through committees, a list of which presents in a different light the objectives of the Division:

Fundamental Principles
Thermo-physical Properties
Testing Technique
Heated and Cooled Enclosures
Unfired Equipment
Direct-Fired Fluid Heaters
Direct-Fired Solid Heaters

E. D. GRIMISON, *Chairman*

HEAT TRANSFER DIVISION • Organized 1938 • Divisional Status 1941

CHAIRMAN
E. D. GRIMISON (1941)
Engr., Babcock & Wilcox Co.
85 Liberty Street,
New York, N. Y.

GROUP SECRETARY
W. S. PATTERSON,
Engr., Combustion Engrg. Co.,
200 Madison Avenue,
New York, N. Y.

RESEARCH SECRETARY
T. B. DREW,
Assoc. Prof. Chem. Engrg.,
Columbia University,
New York, N. Y.

EXECUTIVE COMMITTEE

T. B. DREW (1942)
Assoc. Prof. Chem. Engrg.,
Columbia University,
New York, N. Y.

H. C. HOTTEL (1943)
Assoc. Prof. Fuel Engrg.,
Massachusetts Inst. of Tech.,
Cambridge, Mass.

R. A. Bowman (1944)
Section Engr.,
Westinghouse Elec. & Mfg. Co.,
Philadelphia, Pa.

L. M. K. BOELTER (1945)
Prof., University of California,
Berkeley, California.

JUNIOR REPRESENTATIVES

R. H. WOLIN,
Proposition Engr.,
Combustion Engineering Co.,
200 Madison Avenue,
New York, N. Y.

J. L. MENSON,
Engr., Superheater Co.,
Industrial Div.,
East Chicago, Ind.

ADVISORY ASSOCIATES

C. E. LUCKE,
Prof. Mech. Engrg.,
Columbia Univ., New York, N. Y.

J. H. SENGSTAKEN,
Charge Sales, Air Preheater Corp.,
60 East 42nd Street,
New York, N. Y.

A. K. SCOTT,
Standard Oil Development Co.,
Elizabeth, N. J.

R. C. H. HECK,
Prof., Rutgers University,
Brunswick, New Jersey.

R. J. S. PIGOTT,
Staff Engr.,
Gulf Research & Developing Co.,
P. O. Box 2038, Pittsburgh, Pa.

O. KENNETH BATES,
Prof., St. Lawrence University,
Canton, New York.

COMMITTEES

Testing Technique:
H. C. HOTTEL, *Chairman*
Assoc. Prof. Fuel Engrg.,
Massachusetts Inst. of Tech.,
Cambridge, Mass.

Papers:
W. L. DE BAUFRE, *Chairman*,
Chmn., Dept. of Engrg. Mech.,
University of Nebraska,
Lincoln, Nebr.

Thermo-Physical Properties of Materials:
R. H. NORRIS, *Chairman*,
General Engineer,
Lab. General Electric Co.,
1 River Rd., Schenectady, N. Y.

Specific Heat of Gases
MAX JAKOB, *Chairman*,
Research Professor,
Illinois Institute of Technology,
Chicago, Ill.

Theory and Fundamental Research:
L. M. K. BOELTER,
Chairman,
Prof. Mech. Engrg.,
University of California,
Berkeley, Cal.

Unfired Heat Transfer Equipment:
R. A. BOWMAN,
Chairman,
Section Engr.,
Westinghouse Elec. & Mfg. Co.,
Philadelphia, Pa.

Coordination:
W. S. PATTERSON,
Chairman,
Engr., Combustion Engineering Co.,
200 Madison Avenue,
New York, N. Y.

Direct Fired Fluid Heaters and Boilers:
E. D. GRIMISON,
Chairman,
Engr., Babcock & Wilcox Co.,
85 Liberty Street,
New York, N. Y.

Industrial Furnaces and Kilns
W. TRINKS, *Chairman*,
Prof.,
Carnegie Inst. of Tech.,
Pittsburgh, Pa.

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS, 29 West 39th St., New York, N. Y.

This Announcement is One of a Series—*Aviation, April—Management, May—Hydraulic, June—Oil and Gas Power, July—Applied Mechanics, August—Process Industries, September—Railroad, October—Fuels, November*

For every industrial service there is a JOHNS-MANVILLE INSULATION specially designed to provide highest operating efficiency, long life and maximum fuel savings - - -

Here are brief facts on a few of the most widely used J-M Insulations. For full details, and for information on J-M Insulation Engineering Service, write Johns-Manville, 22 E. 40th St., New York, N.Y.

• • •

FOR STEAM LINES UP TO 600° F.—J-M 85% Magnesia Pipe Insulation. For many years this material has been proving its ability to maintain its high insulating efficiency in service. It is the most widely used power-plant insulation.

FOR STEAM LINES UP TO 700° F.—J-M Asbesto-Sponge Felted Pipe Insulation is recommended where maximum efficiency, salvage value and resistance to vibration and abuse are essential.

FOR HIGH-PRESSURE SUPERHEATED STEAM LINES—J-M Superex Combination Insulation, consisting of an inner layer of Superex high-temperature insulation and an outer layer of J-M 85% Magnesia or Asbesto-Sponge Felted. Combines unusual heat resistance and high insulating efficiency.

FOR BOILER DRUMS, WATER WALLS, FEED-WATER HEATERS, TANKS, BREECHINGS AND UP-TAKES—J-M 85% Magnesia Blocks for temperatures up to 600° F. Strong, durable, lastingly efficient.

FOR COLD-WATER LINES—J-M Anti-Sweat Pipe Insulation—a cold-water pipe insulation designed to prevent condensation and damage from dripping.

FOR REFRIGERATED SERVICE—J-M Rock Cork Sheets and Pipe Insulation—basically mineral, Rock Cork cannot rot and will not harbor vermin or support mold. It is highly moisture-resistant and retains its unusually high insulating efficiency indefinitely. Widely used for refrigerated equipment and piping, air-conditioning ducts and cold-storage rooms.

FOR FURNACE INSULATION—J-M Superex Blocks, for years the most widely used block insulation for temperatures up to 1900° F. Combines high heat resistance with low thermal conductivity.

J-M Insulating Brick (3 types) and J-M Insulating Fire Brick (4 types) for temperatures up to 2600° F. Furnished in all standard 9" shapes of the 2½" and 3" series, as well as in special shapes.

Also J-M Sil-O-Cel C-3 Concrete, cast on the job from Sil-O-Cel C-3 aggregate and cement. Sets up into a strong, durable semi-refractory insulating concrete for temperatures up to 1800° F.

STANDARD PRESSED STEEL CO.
JENKINTOWN, PENNA. Box 568
— BRANCHES —
BOSTON • DETROIT • INDIANAPOLIS • CHICAGO • ST. LOUIS • SAN FRANCISCO

UNBRAKO
Reg. U. S. Pat. Off.

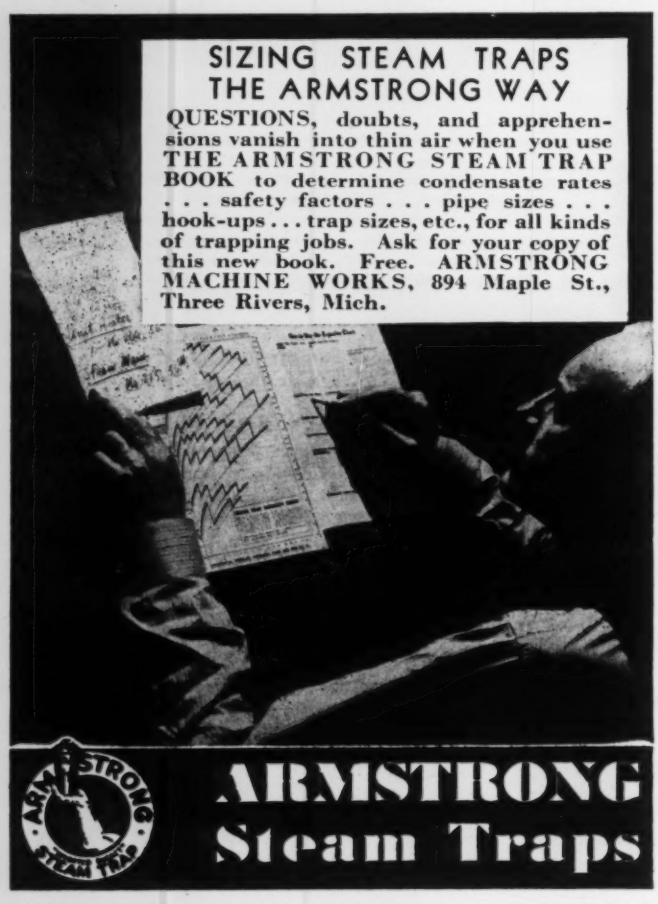
"UNBRAKO" KNURLED SOCKET HEAD CAP SCREWS

Yes . . . the head has it, and it's KNURLING—famous "Unbrako" feature for years and at no extra cost. Dry or greasy fingers gear right to dry or greasy knurls—prevent annoying, time-wasting slip in the assembly line or when making adjustments.

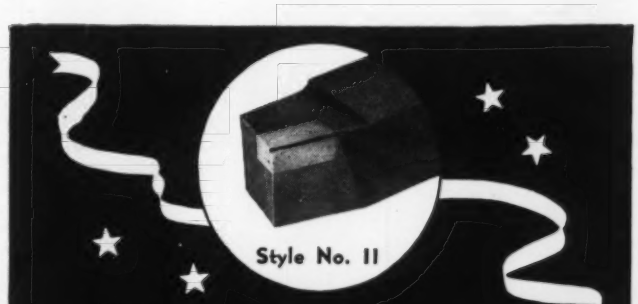
"UNBRAKO" KNURLED SELF-LOCKING HOLLOW SET SCREWS

Set them up with only light pressure and they lock into place automatically with a positive, vibration defying grip. It's the KNURLED cup points that do it. Yet "Unbrako" Self-Lockers are as easily removed as applied, can be used repeatedly.

It will pay to make your next order "UNBRAKO."


SIZING STEAM TRAPS
THE ARMSTRONG WAY
QUESTIONS, doubts, and apprehensions vanish into thin air when you use THE ARMSTRONG STEAM TRAP BOOK to determine condensate rates . . . safety factors . . . pipe sizes . . . hook-ups . . . trap sizes, etc., for all kinds of trapping jobs. Ask for your copy of this new book. Free. ARMSTRONG MACHINE WORKS, 894 Maple St., Three Rivers, Mich.
ARMSTRONG STEAM TRAPS
ARMSTRONG Steam Traps

AMERICAN STANDARDS
A HANDY HANDBOOK
Piping Standards
C I Pipe Flanges and Flanged Fittings
25 lb (B 16b2-1931)
125 lb (B 16a-1939)
250 lb (B 16b-1928)
800 lb (B 16b1-1931)
Malleable Iron Screwed Fittings—150 lb (B 16c-1939)
C I Screwed Fittings—125 and 250 lb (B 16d-1927)
Steel Pipe Flanges and Flanged Fittings—(B 16e-1939)
C I Long Turn Sprinkler Fittings (B 16g-1929)
Face-to-Face Dimensions of Ferrous Flanged and Welding End Valves (B 16.10-1939)
C I Soil Pipe and Fittings (A 40.1-1935)
Pipe Plugs of C. I. Malleable Iron, Coil or Forged Steel (B16e2-1936)
Brass Fittings for Flared Copper Tubes (A 40.2-1936)
Soldered Joint Fittings (940.2-1941)
Steel Butt Welding Fittings (B 16.9-1940)
W. I. and W. S. Pipe (B 36.10)
Scheme for the Identification of Piping Systems (A 13-1928)
Price for Standards and Binder $8.50
10% Discount to A.S.M.E. Members
AMERICAN STANDARDS are developed under procedure of AMERICAN STANDARDS ASSOCIATION
BINDERS and PAMPHLETS FOR SALE BY A.S.M.E. - 29 WEST 39TH STREET, NEW YORK, N.Y.



KENNAMETAL
SPEEDS DEFENSE PRODUCTION

Nitrided cylinder barrels for "Cyclone" engines, bomber landing gear cylinders, gudgeons for marine steam engines, clutch plates for Army tanks—these are but a few of the hard steel parts for all types of armament now being machined at high speeds with KENNAMETAL, the accepted steel-cutting carbide. KENNAMETAL turns, bores, and faces these hard steel parts in 30 to 50% less time than required by high speed steel, and produces a smooth, accurate surface, often in one cut.

Meet today's heavy production demands with fast-cutting KENNAMETAL carbide tools. Quick deliveries are made on Standard and Modified Standard Tools and Blanks. Write for our new Catalog No. 42.

McKENNA METALS Co.
367 LLOYD AVE., LATROBE, PENNA.
FOREIGN REPRESENTATIVES: U. S. STEEL EXPORT CO.
(Exclusive of Canada, Great Britain and Possessions)

At last... an ALL-PURPOSE block insulation!

EFFECTIVE FOR FULL RANGE OF OPERATING TEMPERATURES TO 1700° F.

Easy application. Eagle Supertemp Blocks can be applied in single layer construction. A great economy.

Quickly cut with a knife.

Permanent. Do not disintegrate or lose efficiency under normal operating conditions.

Made of mineral wool. Fireproof; water repellent; chemically and physically stable.

Light weight — Approximately 18 lbs. per cubic foot. Contains myriads of "dead air cells" essential to high efficiency.

Write today for free sample and complete specifications

THE EAGLE-PICHER LEAD COMPANY, Cincinnati, Ohio

Among Eagle Insulating Materials are

Eagle Super "66" Cement	Eagle Loose Wool
Eagle Supertemp Blocks	Eagle Insulseal
Eagle L-T Felts	Eagle Insul-stic
Eagle Blankets	Eagle Finishing Cements

See Sweet's Catalog for specifications

EAGLE EP PICHER

Temporary Laboratory Bldg. Wright Field, near Dayton, Ohio
Official Photograph—U.S. Army Air Corps.

BANISH NOISE *with* Careyduct
THE ALL-ASBESTOS INSULATED DUCT

CAREYDUCT, a natural sound absorber, "hushes" fan noises, cuts down speaking tube effects, reduces outside noises, eliminates metallic "cracking" due to change in air pressure.

CAREYDUCT is a standardized factory built duct for conveying conditioned air (either hot or cold). This all-asbestos prefabricated duct combines both Duct and Insulation in strong, rigid fireproof units. Cuts easily—all fittings may be made on the job, eliminating shop work and overhead. Simple slip-joint construction of duct and quickly constructed fittings, make erection rapid and economical. Write Dept. 63 for details.

THE PHILIP CAREY MFG. COMPANY • Lockland, Cincinnati, Ohio

Those tangents on WeldELLS are for you!

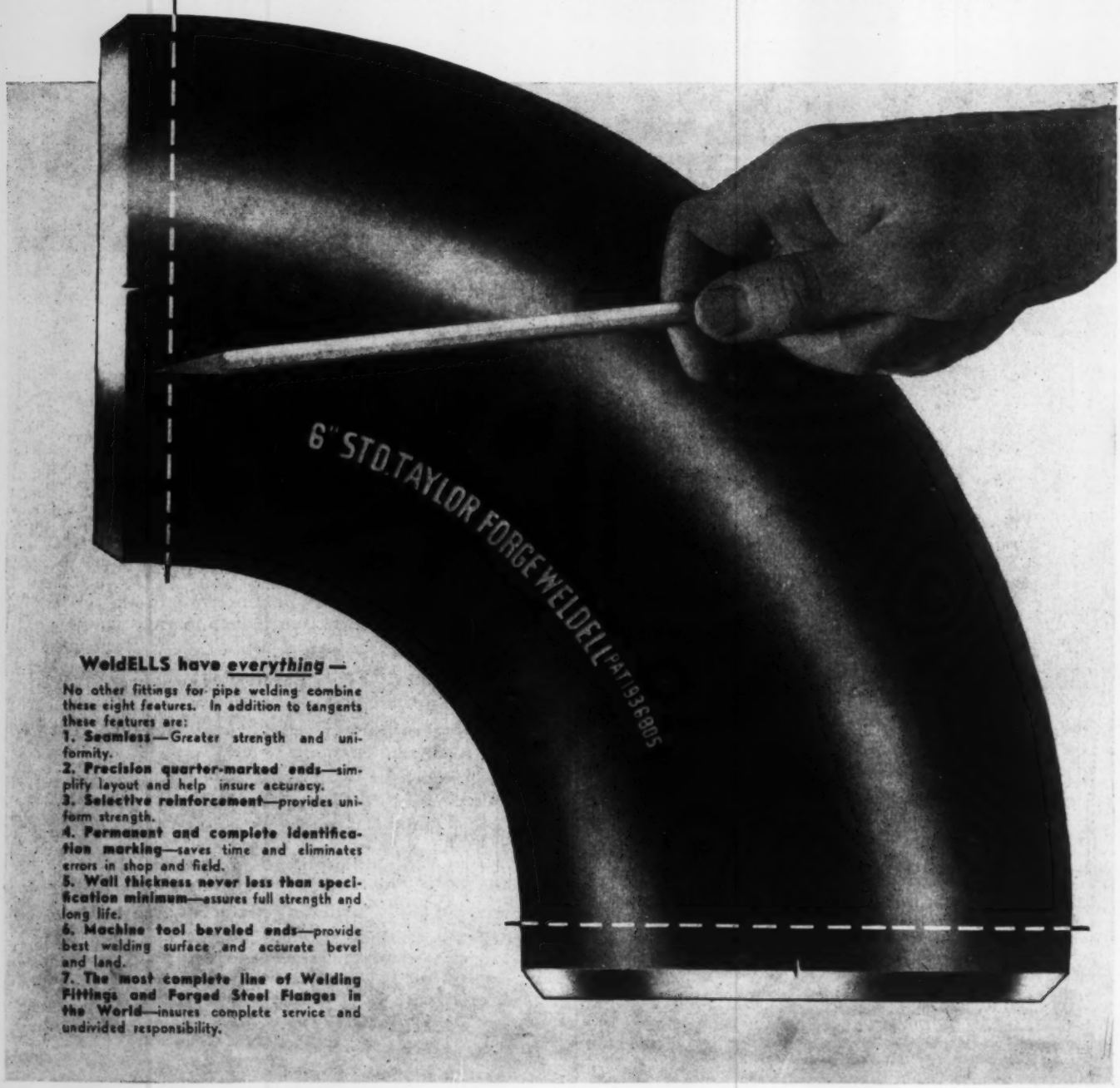
THE accurately formed straight segments on each end of every WeldELL are placed there for *your* benefit—to give *you* better engineered piping at lower cost.

They keep the weld away from the zone of highest stress, make lining up easier and facilitate the use of slip-on flanges with WeldELLS.

Tangents provide just one of *eight* good reasons for insisting on WeldELLS. Seven other extra value features are listed below.

► WeldELLS and other Taylor Forge Fittings for Pipe Welding and Forged Steel Flanges are stocked by authorized distributors in all principal cities. Ask your local distributor for a copy of Taylor Forge Catalog No. 401.

TAYLOR FORGE & PIPE WORKS, General Office & Works: Chicago, P. O. Box 485
New York Office: 50 Church Street • Philadelphia Office: Broad Street Station Bldg.



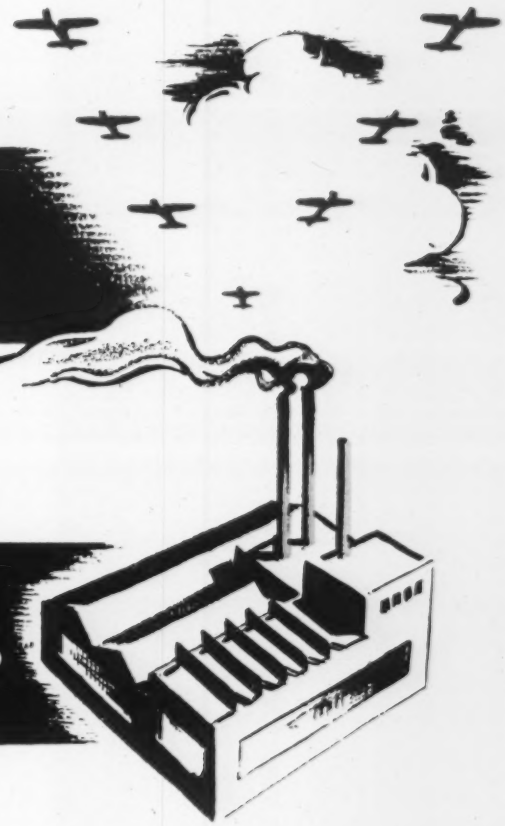
WeldELLS have *everything*—

No other fittings for pipe welding combine these eight features. In addition to tangents these features are:

1. **Seamless**—Greater strength and uniformity.
2. **Precision quarter-marked ends**—simplify layout and help insure accuracy.
3. **Selective reinforcement**—provides uniform strength.
4. **Permanent and complete identification marking**—saves time and eliminates errors in shop and field.
5. **Wall thickness never less than specification minimum**—assures full strength and long life.
6. **Machine tool beveled ends**—provide best welding surface and accurate bevel and land.
7. **The most complete line of Welding Fittings and Forged Steel Flanges in the World**—insures complete service and undivided responsibility.

Protection today . . .

Progress tomorrow . . .



with **EVERDUR!**

You would naturally expect this high-strength, workable, weldable copper-silicon alloy to be serving national defense in many ways. It is—in every armed service, and in the production equipment of many war-vital industries.

For good reasons, too!

Where and why Everdur is used in National Defense . .

ANACONDA THE AMERICAN BRASS COMPANY • WATERBURY, CONNECTICUT

Research which developed *Everdur* offers many other Copper-Base Alloys

The Research Department of The American Brass Company has developed many of the copper-base alloys now in common use for special types of service. In addition, this research today is devoted to furthering the usefulness of Anaconda Metals to the defense program. The Technical Department of this Company is prepared to cooperate in determining the one best metal for a specific application and the correct procedure for its fabrication.

PRINCIPAL PRODUCTS

COPPER, BRASS, BRONZE AND NICKEL SILVER — SHEETS, WIRE, RODS, TUBES

Beryllium Copper	Condenser Tubes	Everdur Tank Plates	Phosphor Bronze
Brass Pipe	Copper Tubes	Extruded Shapes	Pressure Die Castings
Brazing Solder	Copper Tube Fittings	Eyelets, Grommets, etc.	Hot Pressed Parts
Bronze Screen Wire	Drawn Sections	Flexible Metal Hose	Tobin Bronze Shafting
Bus Bars and Shapes	Electrical Conduit	Free Cutting Brass Rods	Welding Rods

ANACONDA
from mine to consumer

THE AMERICAN BRASS COMPANY

General Offices: Waterbury, Connecticut • Subsidiary of Anaconda Copper Mining Company

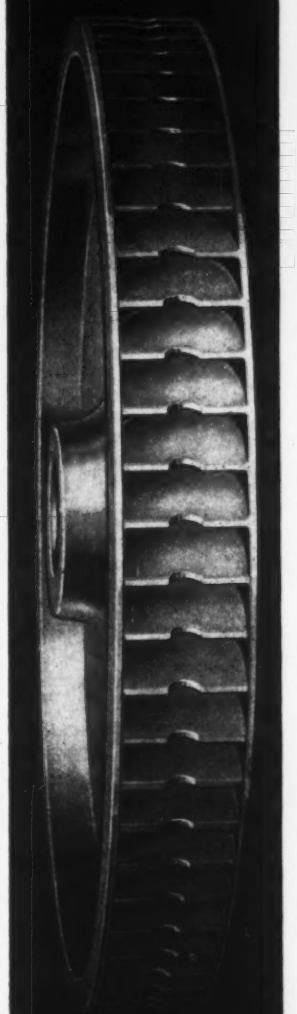
MANUFACTURING PLANTS—Ansonia, Conn. • Buffalo, N. Y. • Detroit, Mich. • Kenosha, Wis. • Torrington, Conn. Waterbury, Conn.

OFFICES AND AGENCIES—Atlanta, Ga. • Boston, Mass. • Buffalo, N. Y. • Chicago, Ill. • Cincinnati, Ohio • Cleveland, Ohio Denver, Colo. • Detroit, Mich. • Houston, Texas • Kenosha, Wis. • Los Angeles, Calif. • Milwaukee, Wis. • Minneapolis, Minn. Newark, N. J. • New York, N. Y. • Philadelphia, Pa. • Pittsburgh, Pa. • Providence, R. I. • Rochester, N. Y. • St. Louis, Mo. San Francisco, Calif. • Seattle, Wash. • Syracuse, N. Y. • Washington, D. C. • Waterbury, Conn.

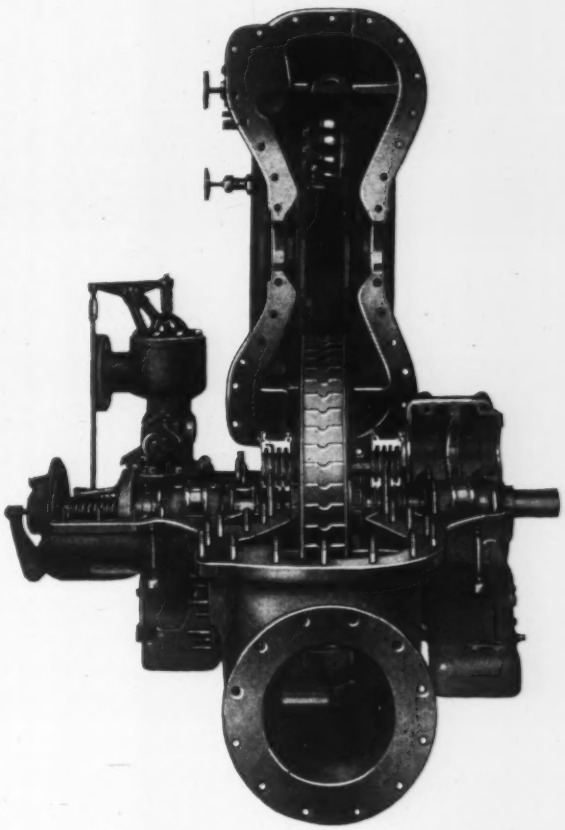
WAREHOUSES: Chicago, Ill. • Cleveland, Ohio • Milwaukee, Wis. • Philadelphia, Pa. • Providence, R. I.

IN CANADA: Anaconda American Brass Limited. Manufacturing Plant and General Office, New Toronto, Ontario Montreal Office: 939 Dominion Square Building

TERRY



SOLID WHEEL TURBINES are DOUBLE-RIM PROTECTED



In Terry Wheel Turbines the blades are protected by rims at the sides of the wheel, which would take without damage any rubbing that might occur if the clearance became reduced.

With this construction it is impossible for the blades to foul and frequent inspections of the thrust bearing are not required to obtain safe and dependable operation.

This and many other features of Terry wheel turbine design are fully described in our bulletin S-116. A request on your business letterhead will bring a copy.

Above:
Typical Terry Wheel Turbine with cover raised. Unit is rated 400 HP at 3500 RPM with steam conditions of 650 lbs. — 825°TT — 2 lbs.

T-1140

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

THE GREATEST OPPORTUNITY IN 100 YEARS

It has been predicted that the average level of business will reach the highest production point of a hundred years. What an opportunity for engineers and executives to promote the health, comfort and efficiency in business, commerce and industry! What an incentive to visit the 7th International Heating and Ventilating Exposition—the Air Conditioning Exposition—at Philadelphia in January!

Never before was there so much to be learned about modern heating, ventilation and air conditioning—never a greater opportunity to apply knowledge with profit to the Nation and self at the same time.

Visit this Exposition to check up on your ability to decide pressing problems with the assurance that can come only of knowledge confirmed and brought up to date. There is no quicker, surer, better way to conserve your time, find what you need, safeguard investments in heating, ventilating and air conditioning equipment, promote the morale and efficiency of employees, serve your Country and guard your future. Plan now — definitely — to attend with your associates.

7th INTERNATIONAL HEATING & VENTILATING EXPOSITION

The Air Conditioning Exposition

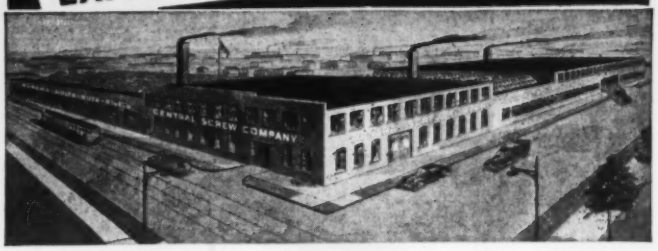
COMMERCIAL MUSEUM • PHILADELPHIA • JANUARY 26-30, 1942

Under the Auspices of American Society of Heating and Ventilating Engineers

MANAGED BY INTERNATIONAL EXPOSITION COMPANY

777

★ EXPANDED FOR DEFENSE!



★ More machines—more skilled help—more production facilities. The picture at Central Screw Company grows busier and bigger with the swelling tide of defense.

Certainly, defense orders for Screws—Bolts—Nuts—Rivets and Special Fastening Devices are getting preferred attention. But, as this message goes to press, Central Screw production is gaining momentum *fast.*

Thus, you can expect earlier delivery schedules, not only for defense requirements but for civilian demands as well, when you send your orders to Central.

CENTRAL SCREW COMPANY

3523 SHIELDS AVENUE • CHICAGO, ILLINOIS

OPPORTUNITY ADVERTISEMENTS

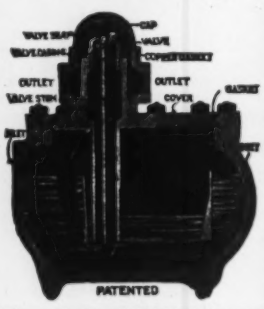
If you desire capital or have it to invest; if you have a patent for sale or development; if you have on hand used machinery for disposal, or if you want such equipment; if you have copies of publications or a set of drawing instruments to dispose of; if you need help or want a position in fact, anything to be offered that somebody else may want or anything wanted that somebody else may have—use a classified advertisement in the Opportunities Section in MECHANICAL ENGINEERING for quick results.

RATES

60 cents a line, 50 cents a line to members of A.S.M.E. Seven words to the line average. A box number address counts as one line. Minimum insertion charge, 5 line basis; maximum 20 lines. Display matter carried in single column units of multiples of one inch at the flat rate of $10 per inch per insertion. Copy must be in hand not later than the tenth of the month preceding date of publication

The American Society of Mechanical Engineers
29 West 39th Street New York, N. Y.

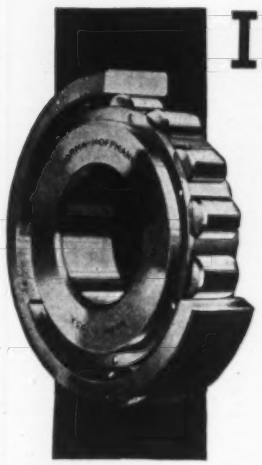
The GENUINE Squires STEAM TRAP



saves your fuel bill as it operates **without** loss of steam.

May we send Catalog H-9 giving complete information.

The C. E. SQUIRES CO., Cleveland, O.



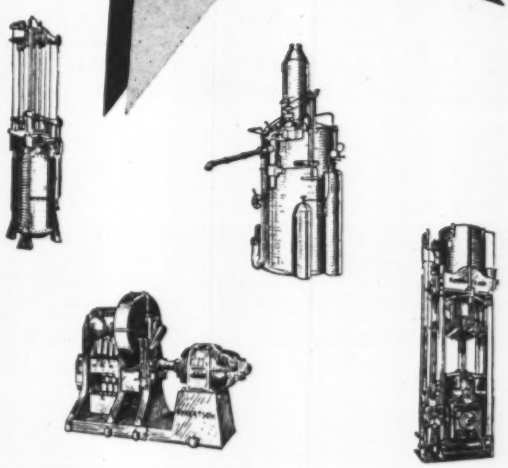
IMPACT RESISTING

WHERE service conditions are most severe—where loads are heaviest—where impact, momentary overloads, and vibration are a problem—there NORMA-HOFFMANN PRECISION ROLLER BEARINGS demonstrate their extraordinary ability to absorb punishment. Short parallel roller design—the use of a heavy-duty, completely machined bronze retainer—extreme refinement of workmanship and finish—these factors combine to give these PRECISION Roller Bearings a lower coefficient of friction under heavy loads than any other type of ball or roller bearing, together with a speed-ability equal to that of any ball bearing, size for size. Write for the Catalog. Let our engineers work with you.

NORMA-HOFFMANN BEARINGS CORPORATION
Stamford, Conn., U.S.A.
PRECISION BALL, ROLLER and THRUST BEARINGS

For LATEST LIST of
A.S.M.E. PUBLICATIONS
Consult Pages 247-262
of the
1942
A.S.M.E. MECHANICAL CATALOG
AND DIRECTORY

Our Star Salesmen



Throughout the world there are many users of Robertson Products. For these users, Robertson equipment is saving in production and maintenance costs . . . is giving the consistently fine, long-time service that has ever been associated with the Robertson name.

These users are our star salesmen. Their experience is positive proof of Robertson Quality . . . their recommendations count more than 1,000 claims. Why not consult them and be *sure*?

We will be glad to refer you to those who have used Robertson equipment in your own line of work . . . a note on your letterhead brings this information without obligation.

Robertson makes all types of lead encasing machinery for rubber hose and electrical cable manufacturers, including Extrusion Presses, Hydraulic Pumps, Melting Furnaces and Pots, Dies and Cores, Hydropneumatic Accumulators and Lead Sheath Stripping Machines.

JOHN ROBERTSON CO., INC.
121-137 WATER STREET, BROOKLYN, N. Y.

☆ GENERAL CABLE ☆ ROEBLING ☆ SWAN ☆ BOSTON ☆ GOODYEAR ☆ U.S. RUBBER ☆ WESTERN ELECTRIC

☆ NORTHERN ELECTRIC ☆ GOODRICH ☆ THERMOID ☆ GENERAL ELECTRIC ☆ BISHOP WIRE

YARWAY SEATLESS BLOW-OFF VALVES
NO SEAT TO SCORE, CLOG, WEAR, LEAK

Send for Celluloid Working Model and Catalog A-430

More than 10,000 installations

YARWAY

YARNALL-WARING CO PHILADELPHIA, PA.

INDICATING PRESSURE AND VACUUM GAGES

Published August 1939
Price 40c
(10% Discount to A.S.M.E. Members)

This new American Standard has been developed to insure uniformity of the important appearance factors, nomenclature, purchase specifications, and tests. It applies to round dial-type indicating gages utilizing an elastic-chamber for confining the pressure medium. Information to be found in its pages include:

Concise descriptions of gages; definitions of pressure characteristics; classification of the elastic-chamber; description of single and multiple elastic-chamber gages, and of specific service type gages; structural details; description of auxiliaries; and a discussion of manufacturing and operating variables.
General requirements—a chapter dealing with mounting holes; stop pins; location, type, and size of pressure connections.
Tables giving gage sizes and dimensions, dial ranges, grades of accuracy and values of graduations.
Rules governing indicating pointer.
Accuracy requirements and test procedure for determining the accuracy of gage.
Rules for Installation and use.
Suggested form for gage purchase specification.
Sample table showing results of the test of a gage.

Publication-Sales Department ◆ The American Society of Mechanical Engineers ◆ *29 West 39th Street, New York*

"Consistent high quality and long life."

The manager of a well known manufacturer of outboard motors has that to say about the TANNATE Leather Belts that have been giving up to 10 years highly satisfactory service in his plant. The TANNATE belt shown here on a boring machine was installed in 1934. Performance is the best proof of quality.

With today's speeded-up production schedules to be met, the choice of *high quality* belting is more important than ever. It is an assurance of continued operation without the loss of time for maintenance or replacements. TANNATE Watershed keeps machines operating at peak efficiency. Exceptional grip, great strength and flexibility permit TANNATE to transmit more power with less tension and less bearing friction than most oak belting. Furthermore, TANNATE has high resistance to heat, moisture, oil, and certain chemicals. For all the facts about TANNATE, write today.

J. E. RHOADS & SONS • 35 N. Sixth St., Phila., Pa.
Established 1702 — NEW YORK • CHICAGO • ATLANTA • CLEVELAND

STEP UP PRODUCTION with
RHOADS *Tannate*
WATERSHED LEATHER BELTING

PLANT ENGINEER WANTED

Large industrial company with chemical plant in the East has opening for experienced Engineer. Applicants should have a degree in Chemical or Mechanical Engineering and from 10 to 15 years of practical experience in chemical plant layout, equipment design, construction and maintenance.

Reply, in confidence, giving full details of your training, experience and special qualifications, state nationality and salary requested and attach small photograph. Our own staff is advised of this advertisement.

Address: ME-1010
Care of MECHANICAL ENGINEERING

MECHANICAL ENGINEERING
November, 1941 CARD INDEX Vol. 63, No. 11

The Cover, Silhouette of Midtown New York
The Watts Bar Steam Power Station of the TVA, G. R. Rich and R. T. Mathews 773
Fuels and Lubricants in National Defense, C. M. Larson 780
Modern Shell Forging and Torpedo-Body Production, A. B. Cudebec and Erwin Loewy 783
Plastics Applied to Airplane Structures, C. F. Marschner 787
Cooling-Tower Progress, L. T. Mart 791
Substitution of Molybdenum for Tungsten 798
Coal-Handling Systems for Central Stations, G. C. Daniels 801
The Selection of Subordinate Personnel, H. C. Taylor 807
The Honing Process in National Defense, A. M. Johnson 811
Engineers in Postwar Planning, A. M. Selvey 814
Spending Our Way to Prosperity, H. C. Buxton, Jr. 815
Editorial 771
Briefing the Record 817
Comments on Papers 824
Reviews of Books 829
A.S.M.E. News 832

Pat'd and Pat's Pending Cutout section showing locking ring in place

UNSHAKO SELF-LOCKING NUT

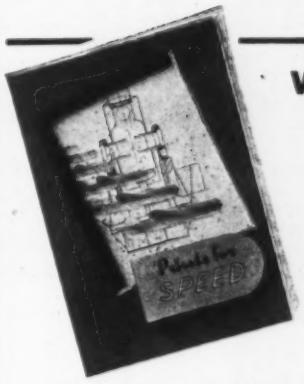
CLAMPS DOWN on vibration!

Put "UNSHAKO" to work on your equipment . . . watch it HOLD with a relentless grip!

The built-in, self-energizing locking ring is always on guard . . . defeats any backing off tendency.

"UNSHAKO" s easily backed off with a wrench, saves maintenance time and breakdown trouble. For details, write

STANDARD PRESSED STEEL CO.
JENKINTOWN, PENNA. Box 558



THIS BOOK SHOWS HOW TO CUT PRODUCTION DELAYS!

WHAT YOU'LL FIND IN THIS NEW BRUNING BOOK

- ★ How to produce prints in seconds—instead of minutes—and without washing or drying.
- ★ How BW Prints speed production all along the line.
- ★ Big volume print production with only one operator.
- ★ A complete print department in 8 x 8 space—with no plumbing connections.
- ★ How to eliminate waste and trimming with BW Prints.
- ★ Duplicating tracings quickly and inexpensively with transparent BW Prints.
- ★ Preventing mistakes in reading and interpreting prints.
- ★ Saving electric current costs with BW equipment.
- ★ Amazing new features of Bruning printers and developers.

HERE'S a book that gets right down to cases on one of today's biggest problems—getting more speed in production!

It's written for every plant executive—engineer—chief draftsman—who wants to shorten the gap between plan and product . . . eliminate costly delays . . . and save print production costs at the same time.

"Prints for Speed" gives the basic reasons why Bruning Black and White Prints are used by thousands of progressive companies today—including practically every major aircraft company. It shows how these black line prints can quicken the pace of *your* production—bring you important time- and cost-saving advantages.

Send today for your copy of "Prints for Speed."

BRUNING *Since 1897*

SPEEDS—SIMPLIFIES—AND PROTECTS A NATION'S DRAFTING

New York • Chicago • Los Angeles • Boston • Detroit • Houston • St. Louis
Kansas City • Milwaukee • Newark • Pittsburgh • San Francisco • Seattle

IT'S FREE...

"PRINTS FOR SPEED" IS YOURS WITHOUT COST OR OBLIGATION

JUST MAIL THE COUPON!

1192-219A

CHARLES BRUNING CO., *Inc.*
New York: 100 Reade Street
Chicago: 4700 W. Montrose Avenue
Los Angeles: 919 So. Maple Avenue

Gentlemen: Please send me a copy of your new book, "Prints for Speed."

Name.....

Company.....

Address.....

WHAT'S INSIDE OF A *NON-LUBRICATED*

L-R FLEXIBLE COUPLING

(TYPE HQ)

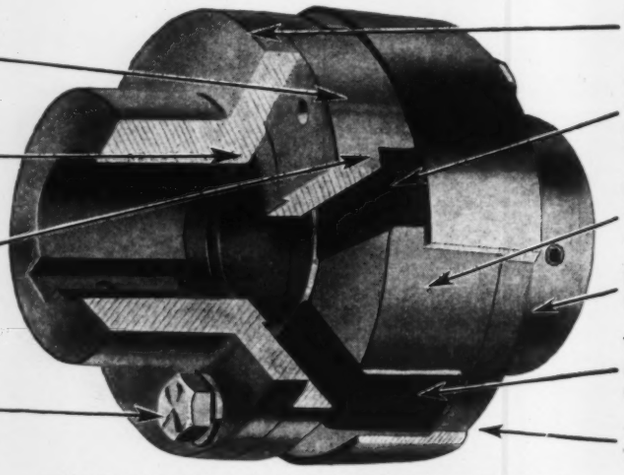
. . . . . a flexible coupling that compensates for offset and angular misalignment—yet can be lined up easily and quickly

One set of jaws (or both) in form of a removable ring. Advantageous where connected machinery must be removed radially, or where independent rotation of shafts is desired. Reduces overall lengths!

⅛" pilot holds removable jaw ring.

Gap between cushions and removable jaw body is 3/16"—when removable ring is pulled over, there is a ⅛" clearance for rotating either half of the coupling. *This independent rotation is a great time saver for setting and timing engines.*

Removable ring held in place with 3 to 9 alloy steel cap screws. For disconnecting, just take out and reverse cap screws. It is not necessary to remove steel collar or load cushions.



Either side can be lifted out without disturbing coupling halves or load cushions.

Load cushions supplied to requirements—rubber, leather, rubber-duck, brake lining, etc. Cushions prevent metal to metal contact. There is no wear on metal jaws.

Power stream carried through one set of metal jaws through resilient cushions to another set of metal jaws.

Electro-steel body and jaws provide greater load-carrying capacity.

Individual load cushions float freely between jaws, held in position by inner sleeve and removable collar.

16 standard sizes from 1⅜" to 8½" bores, 3.91 H.P. to 744 H.P. at 100 r.p.m.

THE NEED NOW IS FOR QUICK DELIVERIES

Lovejoy makes a full line of non-lubricated flexible couplings for practically every coupling use. Sizes from 3/16" to 14" bores, from 1/12 to 2500 H. P. at 100 r. p. m. Many sizes in stock for quick delivery and, nine times out of ten, a standard unit will serve your requirements. Write for catalog of these standard L-R Flexible Couplings.

LOVEJOY FLEXIBLE COUPLING CO. 4957 WEST LAKE ST. CHICAGO, ILLINOIS

That "Better Mouse Trap"

. . in the Woods and OUT

A lot of people believe the story of the world beating a path to the door of the man who makes a *better* mouse trap, though the man live in the woods.

A lot more people give credit for the story to Mr. Emerson.

If Emerson said it he was merely quoting. Thoreau, not Emerson, is the author of the better-mouse-trap-in-the-woods story.

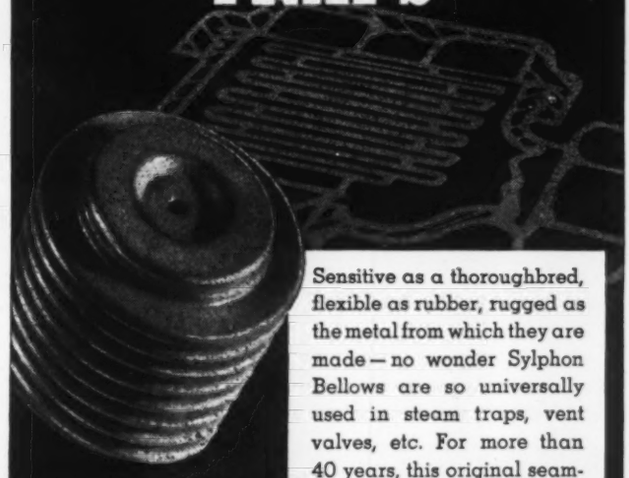
This misplacing of credit shows the importance of bringing things out of the woods . . into FULL view . . where people can see them.

If the right people see them, and understand them, so much the better.

The right people are particularly important in the selling of industrial equipment.

It is among such men that MECHANICAL ENGINEERING is important.

THERMOSTATIC TRAPS



Sensitive as a thoroughbred, flexible as rubber, rugged as the metal from which they are made — no wonder Sylphon Bellows are so universally used in steam traps, vent valves, etc. For more than 40 years, this original seamless, all-metal diaphragm has been the subject of intensive research and development. Write for Bulletin XM-535.

THE FULTON SYLPHON CO., KNOXVILLE, TENN.

You've saved
two million lives
... so far!

SINCE 1907, when the fight began, the tuberculosis death rate has been reduced 75%! — by people like you buying Christmas Seals. More than two million lives have been saved.

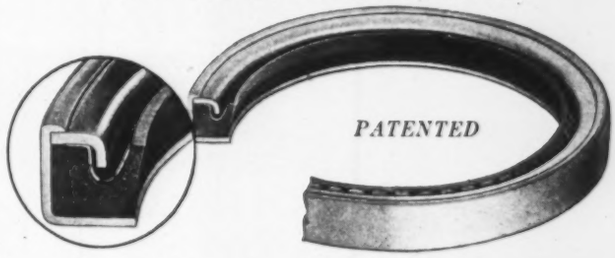
But the battle against this scourge must go on. *Tuberculosis still kills more people between the ages of 15 and 45 than any other disease.*

Yet it is possible to eliminate completely this enemy of mankind. Our weapons are Research, Education, Prevention, Control—made possible by your use of Christmas Seals. Get them today.

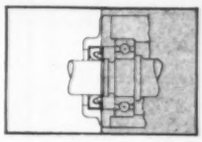
Buy
CHRISTMAS
SEALS

HERE'S WHY OUR
MAINTENANCE COSTS ARE *DOWN*

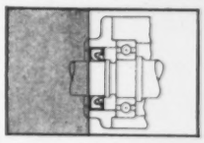
WE INSTALLED
GARLOCK KLOZURE OIL SEALS
TO PROTECT OUR BEARINGS



THEY KEEP
OIL AND GREASE IN



THEY KEEP DUST,
DIRT AND WATER OUT



Production goes up and maintenance costs go down when your bearings are protected with Garlock KLOZURE oil seals. Insure against shut-downs due to bearing failures by installing these sturdy, effective and economical seals. Complete range of sizes including KLOZURES made to bearing manufacturers' standard metric bore sizes.

Write for Folder!

THE GARLOCK PACKING CO., PALMYRA, N.Y.
In Canada: The Garlock Packing Co. of Canada Ltd., Montreal, Que.

GARLOCK KLOZURE

HALLOWELL

STEEL BENCHES

Recognized for many years as the standard in bench equipment, the "Hallowell" line incorporates all the features to meet today's requirements.

Such advantages as smooth tops of steel, laminated wood or Masonite . . . lasting rigidity without bolting to the floor . . . extra sturdy construction throughout . . . interchangeability for quick and comprehensive re-arrangement of benching—are available in each of the 1,367 styles and models in the "Hallowell" line.

These prefabricated benches are *THE* answer to quick setup for sudden expansion demands . . . the answer to permanent requirements wherever there's work to be done. Details are yours free on request. Write—

A smart and useful member of the DeLuxe line of "Hallowell" benches. Interchangeable drawer and shelf units.

Fig. 1729

STANDARD PRESSED STEEL CO.

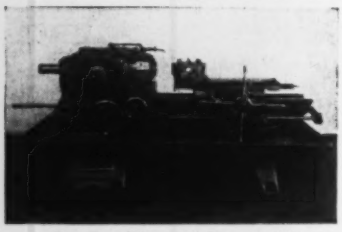
JENKINTOWN, PENNA. BOX 558

— BRANCHES —

BOSTON · DETROIT · INDIANAPOLIS · CHICAGO · ST. LOUIS · SAN FRANCISCO

Universal Turret Lathes Fay Automatic Lathes
Automatic Thread Grinders

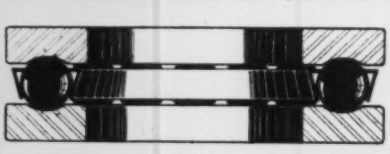
PROJECTION COMPARATORS for Inspection and Measurement



AUTOMATIC THREAD CUTTING DIES and CHASERS

Ram Type Universal Turret Lathe

JONES & LAMSON MACHINE CO.
SPRINGFIELD, VERMONT. U. S. A.



BALL THRUST BEARINGS

Standard sizes are shown in our general catalog.

STANDARD SIZES OR SPECIAL DESIGN to your specifications; send sketch or worn sample, regardless of condition, for quotation, without obligation. ● Our complete catalog will help you in making selection of bearings—shall we send it?

THE GWILLIAM CO. 360 FURMAN ST., BROOKLYN, N. Y.

It can be *Your* Library Department!

A trained staff and a fully equipped library would be a valuable addition to your company. The Service Bureau of the Engineering Societies Library can be that new department in your organization, yet more adequately manned and better equipped than any individual organization library could possibly be.

Use this service. Over 4,000 bibliographies on engineering subjects are on file. 150,000 engineering texts and files of every worthwhile periodical are available for further research to meet your specific needs. A letter, a telephone call or a telegram will place the Service Bureau at your service.

Use the service of *your* Engineering Library

The charges cover only the cost of the service and represent but a fraction of the value you will receive.

The Engineering Societies Library
29 West 39th Street, New York, N. Y.

IF you use resistance welding, investigate the increased production made possible by OHIO WELDING NUT and BOLT PRODUCTS.

SQUARE NUT

RECTANGULAR BOSS

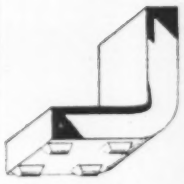
G-2

H-1

H-2

PG-2

PH-1



BRACKET

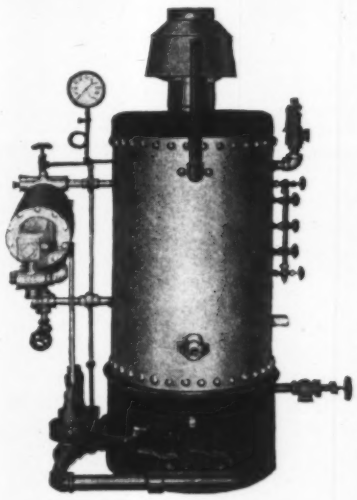
for information and samples, write to

THE OHIO NUT & BOLT COMPANY

602 NORTH FRONT STREET, BEREA, OHIO

MKAYO GAS-FIRED BOILER

Popular Priced, Up-to-the-minute, Efficient!



Here are just a few of the features that qualify MKayO for your process steam requirements:

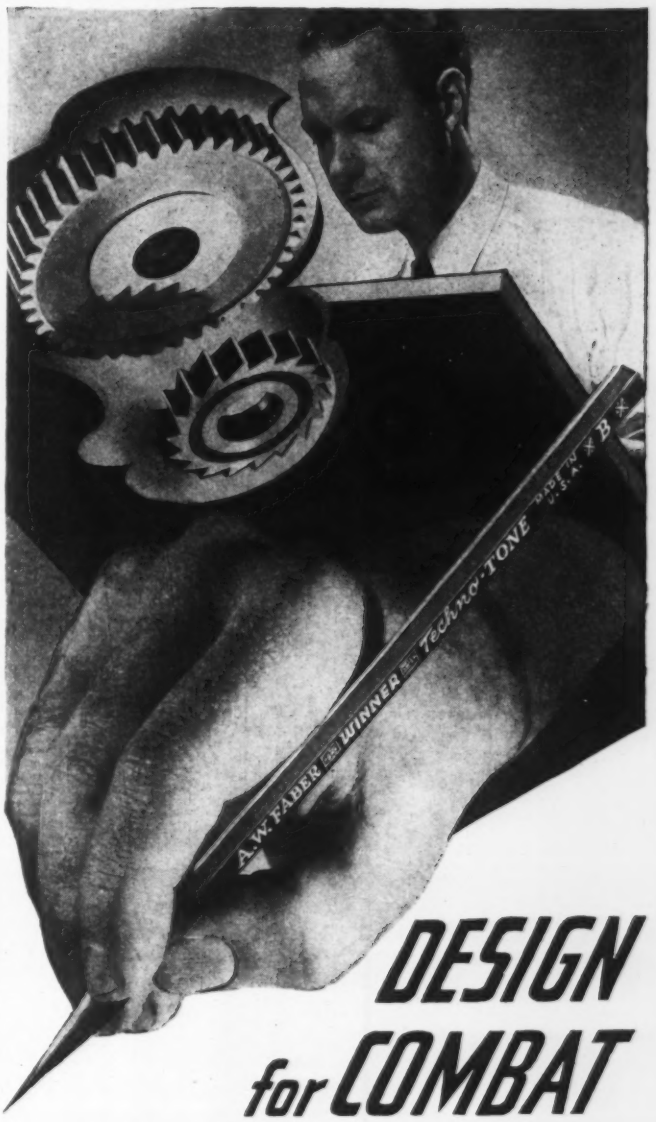
Neat, compact installation and small floor space . . . convenience of location . . . simplicity of operation . . . cleanliness!

Best of all, gas is used only in proportion to steam demand. This means real fuel economy plus controlled steam, constant pressures and temperatures.

Used with the M-K-O boiler feed and condensate return system it's the perfect setup. Bulletin 6 gives details. Write for it today.

MEARS-KANE-OFELDT INC.

1903-1915 E. HAGERT ST., PHILADELPHIA, PA.



DESIGN for COMBAT

Let's glance over the shoulders of the men in the drafting rooms. One man designs gears, another valves, another bearings—and still another the foundation for ship ways. All dove-tailing in America's gigantic Defense Production. Many using A.W. Faber's WINNER Techno-TONE drawing pencils.

For WINNER Techno-TONE is a grit-free, smooth gliding marvel of precision grading and rich tone. A drawing pencil that coaxes creative ideas. In short, a drawing pencil bearing the famous A. W. Faber name, with 180 years of experience behind it. Order WINNER Techno-TONE from your dealer.

WINNER *Techno*-TONE DRAWING PENCIL

translates GRAY MATTER *into* BLACK MATTER

Made in U.S.A. Polished rich green. Packed in metal box. 2 for 25¢

WINNER *Techno*-TONE 17 Degrees—6B to 9H "It has the A.W. FABER name on it."

A·W·FABER·Inc. NEWARK N.J.

A Better Way....

to keep informed about

ENGINEERING SUBJECTS

appearing in the technical literature of the world

THE ENGINEERING INDEX SERVICE prints index cards for articles on all engineering subjects published in the current technical press. A brief annotation covering the subject matter and the source of the article is given. The cards are classified in accordance with that branch of engineering to which they pertain and are mailed weekly to subscribers.

The most important source of information for engineers is the current periodical literature. Here is recorded present-day engineering achievements, methods and experiences, records of past progress and predictions of future trends in every specialized field of engineering.

Domestic and foreign engineering, scientific, technical and trade periodicals including society proceedings, government bulletins and research reports are reviewed by The Engineering Index Service.

THE ENGINEERING INDEX SERVICE is a current guide to the wealth of information in engineering experience of the entire world, and places in the hands of engineers an instrumentality of tremendous worth.

There are 280 divisions of the SERVICE, each dealing with a specialized subject of engineering. Each division may be subscribed for separately and so one need only take that portion of the SERVICE in which he is interested.

The SERVICE is not retroactive. Subscriptions may begin at any time during the year.

A list of divisions, their inclusions, and the subscription rates will be mailed on request

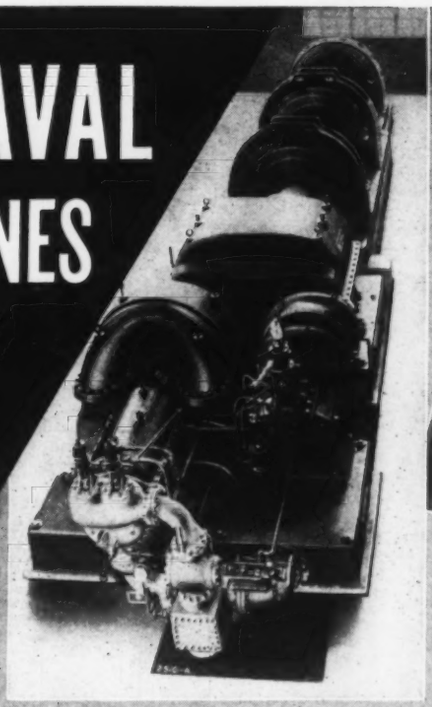
Important articles that have to do with any subject of engineering are annotated, and assembled for quick reference. All the publications are permanently filed by the Engineering Societies Library, New York. Copies of the annotated articles may be procured through the photoprint and translation service of the Library.

There are divisions for every specialist, and many of a general character of interest to every engineer.

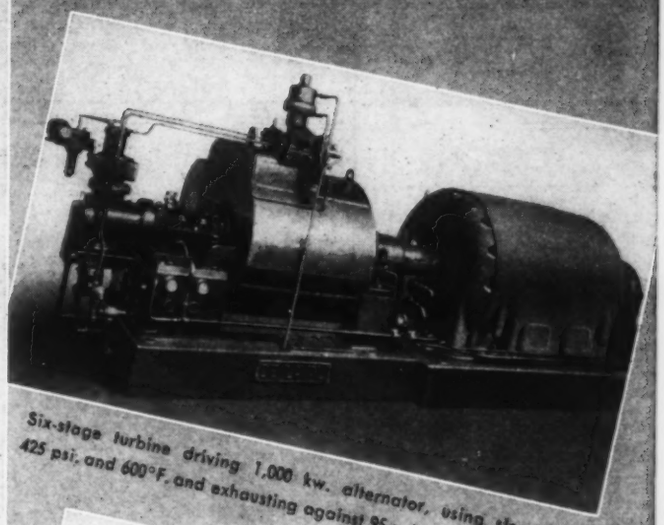
THE ENGINEERING INDEX SERVICE

Published by **ENGINEERING INDEX, INC. 29 West 39th St., New York, N. Y.**

DE LAVAL TURBINES *for* AC or DC Generators



Triple-casing turbine geared to alternating and direct current generators. This type of turbine is highly efficient with steam at high pressure and temperature.

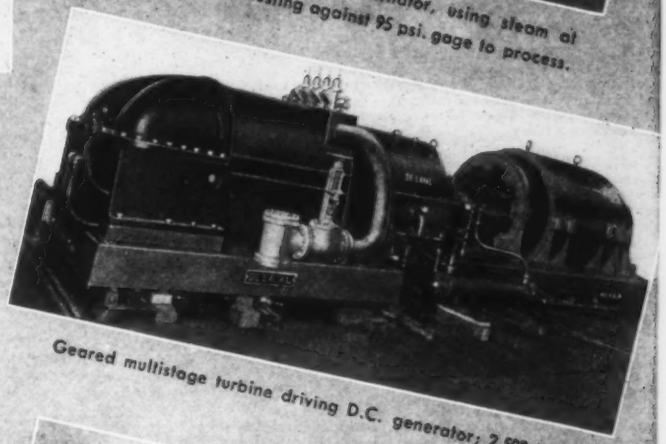


Six-stage turbine driving 1,000 kw. alternator, using steam at 425 psi. and 600°F. and exhausting against 95 psi. gage to process.

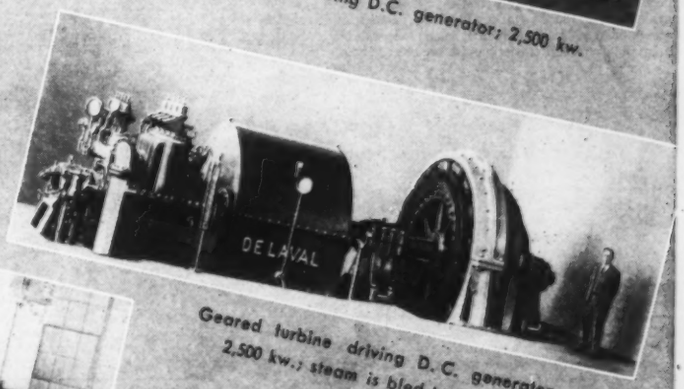
De Laval steam turbines of improved modern design, using high-strength alloys for parts subject to high temperatures and high stress, are now available for direct connection to alternators in capacities up to 15,000 kw., and with double helical speed reducing gears, for driving direct current generators of the same capacities.

Scientific design of rotors and blading, stream-lining of flow passages and separation of moisture from the steam during expansion make possible higher speeds and better steam economies.

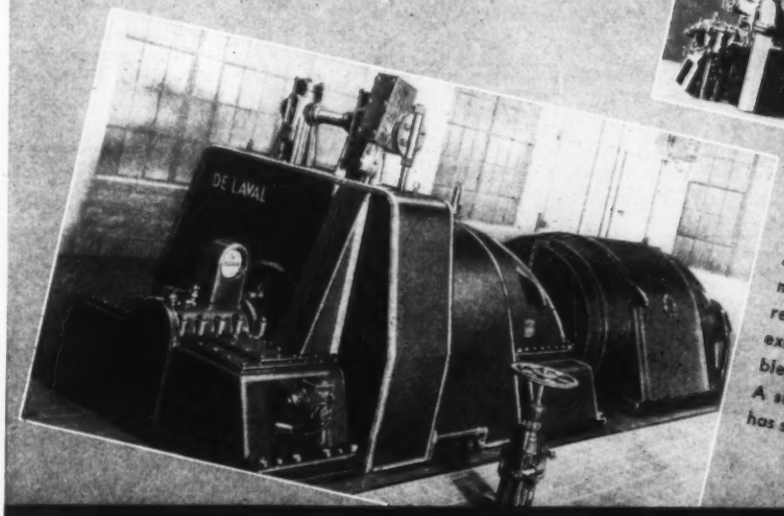
State your conditions and ask for Publication T-3524.



Geared multistage turbine driving D.C. generator; 2,500 kw.



Geared turbine driving D.C. generator; 2,500 kw.; steam is bled to process.



Multistage turbine driving 4,000 kw. (5,000 kw. maximum) 60 cycle alternator. The turbine receives steam at 425 psi. and 720°F. and exhausts to condenser, with provision for bleeding at the 6th, 11th and 15th stages. A similar De Laval unit rated at 6,000 kw. has since been ordered.

DE LAVAL *Steam Turbine Co.*

TRENTON, N. J.

MANUFACTURERS OF TURBINES STEAM HYDRAULIC PUMPS CENTRIFUGAL PROPELLER ROTARY DISPLACEMENT MOTOR MOUNTED MIXED FLOW CLOGLESS SELF PRIMING CENTRIFUGAL BLOWERS and COMPRESSORS GEARS WORM HELICAL and FLEXIBLE COUPLINGS

Representatives—Sales Agencies
Businesses For Sale
Partnership—Capital
Manufacturing Facilities

OPPORTUNITIES

Positions Open—Positions Wanted—Equipment, Material, Patents, Books, Instruments, etc. Wanted and For Sale

RATES Classified advertisements under this heading in MECHANICAL ENGINEERING are inserted at the rate of 70 cents a line. 60 cents a line to members of A.S.M.E. Seven words to the line average. A box number address counts as one line. Minimum insertion charge, 5 line basis, maximum 20 lines. Display matter carried in single column units of multiples of one inch at flat rate of $10. per inch per insertion. Copy must be on hand not later than the 10th of the month preceding date of publication.

POSITIONS OPEN

WANTED

COMPETENT DRAFTSMEN to fill attractive positions relating to experimental development of aircooled engine installations. Aeronautical engineering education and aircraft experience obviously desired but not essential for all positions available. Applications not solicited from persons now employed in aircraft manufacturing industry.

ENGINEERING STRESS ANALYST capable of independent design and analysis of aircraft structures relating to power plant installations. Applications not solicited from persons now employed in aircraft industry.

ENGINEER familiar with aircraft power plant design, fabrications and testing and capable of composing, editing and preparing technical reports, bulletins and manuals relating to this art. Applications not solicited from persons now employed in aircraft manufacturing industry.

AIRPLANE POWER PLANT ENGINEER familiar with mock up practice. Attractive position open to experienced applicant interested in pursuing this form of power plant design development and control for an experimental power plant design group. Applications not solicited from persons now employed in aircraft manufacturing industry.

FLIGHT TEST ENGINEER capable of supervising the assembly of experimental aircraft power plant installations, test instruments and special test equipment, and familiar with both airplane and power plant flight test procedure. Must be able to set up complete flight programs and supervise recording of data in flight. Applications not solicited from persons now employed in aircraft manufacturing industry.

ENGINEERING GRADUATES desiring opportunity to engage in field testing of airplane power plant installations. Depending upon previous experience, if any, applicants must anticipate two to three years of training in dynamometer testing and flight testing. Applications not solicited from persons now employed in aircraft manufacturing industry.

POWER PLANT TEST PILOT to conduct tests specifically in conjunction with experimental development of air cooled engine installations. Desire versatile pilot interested and experienced in engine characteristics rather than in airplane stability and flying qualities. Engineering education desired but not essential.

Apply by letter addressed
to Installation Department

PRATT & WHITNEY AIRCRAFT
East Hartford, Connecticut

Would like to contact MECHANICAL SALES ENGINEER with following among large and small manufacturers. Should be capable of reading blue prints. The position offers a splendid opportunity for the man qualified to represent our organization. In reply, state qualifications fully together with salary requirements, also territory covered. Address CA-590, care of "Mechanical Engineering."

MECHANICAL ENGINEER not over 32 years of age for permanent position, must be competent draughtsman, wanted for opportunity to progress in growing company. Should be graduate engineer having 5 to 7 years experience in industry, preferably mill work. Experience should include work along lines of plant operation and maintenance. Salary $200.00 to $225.00 depending on experience and ability. Location Southern California. Applicants should submit photo and complete history of education and experience. Address CA-595, care of "Mechanical Engineering."

ENGINEERS

Nationally known New Jersey manufacturer needs Mechanical and Electrical Engineers.

Diversified products offer inviting opportunities in engineering field.

MECHANICAL ENGINEERS required for development of processes and machinery for manufacturing and reducing costs of precision apparatus and to plan production methods for assembly and wiring. Also, development, layout, cost reduction work on material handling, storage and packing problems.

ELECTRICAL ENGINEERS needed for high grade work on test set design, special circuits, electronics and vacuum tube manufacture.

Must be Engineering graduates of accredited colleges, high scholastic standing. Some manufacturing experience preferred. Salary commensurate with ability and record of accomplishments.

Must be U. S. Citizens

Write, stating qualifications.
Box 549 Suite 1800,
Times Building, New York, N. Y.

INDUSTRIAL ENGINEERS—Large company engaged in non-defense work has several openings for Chief Industrial Engineers, 8 to 10 years experience in all phases of industrial engineering required. This should include organizational analysis, procedural analysis, departmental layout, materials handling, motion study, time study, cost analysis, wage payment plans. Experience should be diversified, including, if possible, work in the fields of retailing, warehousing, packaging and shipping. To qualify, applicants must possess full academic training (or the equivalent in added engineering experience) in Industrial Engineering, Mechanical Engineering, or Business Administration, and they should be from 30 to 35 years of age. Salary from $4200 to $6000 depending upon individual qualifications.
OTHER OPENINGS for less experienced engineers having some of the qualifications listed above. Ages 25 to 30 years. Salary on these positions will range from $2400 to $4200 depending upon individual qualifications. You may list your present employer as replies will be held in strict confidence. Our own men know of this ad. Address CA-593, care of "Mechanical Engineering."

MAN FOR PATENT DEPARTMENT for Michigan firm with general knowledge of the construction of mechanical, electrical and hydraulic machine tools. Experience in development and research work valuable. Kindly give complete details regarding education, experience, references, place of present employment and salary expected. Information will be held strictly confidential. Address CA-591, care of "Mechanical Engineering."

MACHINE DESIGNER—experienced designer—mechanical engineer preferred—to expand and develop improved lines of equipment of the following types—mechanical presses, plastics molding equipment, high vacuum pumps, and vacuum processing apparatus, as well as certain types of automatic machinery. An excellent opportunity for an outstanding creative designing engineer, with proven ability. F. J. Stokes Machine Company, Olney Post Office, Philadelphia, Pa.

DESIGNING ENGINEER—Barber-Greene Company, Aurora, Illinois, in expanding the Engineering Department, has opportunity for an outstanding creative designing engineer with proven ability and experience on heavy machinery. Age between 30 and 45.

ASSISTANT TO THE MANAGER—An old and well established metal working plant, located in central Indiana, is desirous of securing a capable assistant to the Manager. He must be an engineer with factory, sales and office experience and not over 40 years of age. Must have good personality, ability and ambition. The right man, after proving his ability, will be offered an opportunity to acquire an interest in the business. The plant at present is approximately 50% on defense work with prospects of greatly increasing this percentage. Guaranteed annual salary of $2500.00 with additional yearly bonus depending upon net profits. Address CA-596, care of "Mechanical Engineering."

MECHANICAL ENGINEERING graduates not over 40 for design and assembly layout of boilers and accessory equipment. Knowledge of descriptive geometry and thermodynamic calculations very helpful. Location, Middle West and East. Applications must include full resume of schooling, firms worked for and details of experience. Address CA-548, care of "Mechanical Engineering."

GRADUATE MECHANICAL ENGINEERS preferably under 40 with practical experience in boiler-room operation and knowledge of combustion problems. No applications considered unless accompanied with complete history of applicant's background and experience. Address CA-549, care of "Mechanical Engineering."

BUSINESS OPPORTUNITIES

IDEAS OR INVENTIONS WANTED

Long established manufacturer of medium and heavy precision machinery is in the market for patented or patentable ideas or inventions requiring development for production and marketing. Want items applicable to the defense program or suitable for industrial use after the emergency. Both machinery and other products lending themselves to small volume production will be considered. Send complete details on protected ideas.

***Address:* CA-594,**
care of "Mechanical Engineering"

EMPLOYMENT AGENCIES AND SERVICE BUREAUS

EXECUTIVES, ENGINEERS, DESIGNERS, METALLURGISTS needed for Cleveland area. Good salaries. No fee until placed. Write immediately to Bradley Placement Service, 555 Leader Building, Cleveland, Ohio.

SALARIED POSITIONS

$2,500 to $25,000

This thoroughly organized advertising service of 31 years' recognized standing and reputation, carries on preliminary negotiations for positions of the caliber indicated above, through a procedure individualized to each client's personal requirements. Several weeks are required to negotiate and each individual must finance the moderate cost of his own campaign. Retaining fee protected by refund provision as stipulated in our agreement. Identity is covered and, if employed, present position protected. If your salary has been $2,500 or more, send only name and address for details. R. W. Bixby, Inc., 115 Delward Bldg., Buffalo, N. Y.

E. G. Stroud, Member A.S.M.E., President The Cleveland Engineering Agency Co., 219 Huron-Ninth Building, Cleveland, Ohio, has for 30 years been engaged in technical placement work. Employers wishing to engage Executives, Engineers, Designers, Draftsmen or other technical men are invited to use this service. Applicants available should write for blank and list of opportunities.

ENGINEERS

CHEMICAL • MECHANICAL
ELECTRICAL • STEAM

Permanent positions, non-defense, Southern industries.
Submit full and complete information first letter. Reply to:

BOX 29, DOREMUS & CO. • *Advertising* • **120 BROADWAY, NEW YORK**

DEVOTION TO DUTY IS A TELEPHONE TRADITION
High morale, devotion to duty, ingenuity in meeting new circumstances and the ability and will to work with each other and with the public are traditional characteristics of telephone employees.
Times like these not only demand these characteristics, they serve to create and extend them.
Now, more than ever, the creed of telephone workers is expressed in these simple words . . . "We'll do our best to get your call through."
BELL TELEPHONE SYSTEM

"THE TELEPHONE HOUR" *is broadcast every Monday evening over the N. B. C. Red Network*

Index To Advertisers

The asterisk (*) indicates that firm has a product catalog in the 1942 A.S.M.E. MECHANICAL CATALOG AND DIRECTORY

PROFESSIONAL SERVICE—Page 22 | Keep Informed—Pages 17–22 | OPPORTUNITIES (classified ads)—Page 56

Ahlberg Bearing Co. —
*Air Preheater Corp. —
American Air Filter Co. (Inc.) —
American Brass Co. (Insert) 41–44
A.S.M.E. Publications
Mechanical Catalog 32
Mechanical Engineering 24
News of Publications 28,29
Standards 30
American Telephone & Telegraph Co. 57
Arkwright Finishing Co. 34
*Armstrong Machine Works 38

*Babcock & Wilcox Co. 2nd Cover
*Bailey Meter Co. —
Bantam Bearings Corp. 60
*Barco Mfg. Co. 19
*Barnes-Gibson-Raymond, Div. of Associated Spring Corp. —
*Brown Instrument Co. —
Bruning, Charles, Co. 49
*Buffalo Forge Co. 8

Carey, Philip, Mfg. Co. 39
Carrier Corp. —
Central Screw Co. 46
Chatillon, John & Sons —
Clarage Fan Co. 2
Cleveland Worm & Gear Co. 30
Climax Molybdenum Co. 15
*Cochrane Corp. 23
*Combustion Engineering Co. (Inc.) —
Coxhead, Ralph C., Corp. —

Darnell Corp. (Ltd.) 18
*De Laval Steam Turbine Co. 22, 55
Dixon Typhonite Eldorado Pencils —
*Downingtown Iron Works —
Drop Forging Association —

Eagle Pencil Co. —
*Eagle-Picher Lead Co. 39
Elastic Stop Nut Corp. —
Engineering Index Service 54
Ethyl Gasoline Corp. 26, 27

Faber, A. W. (Inc.) 53
Faber, Eberhard, Pencil Co. —
Fairbanks, Morse & Co. 33
Felters Co. (Inc.) —
*Fiske Bros. Refining Co. 3rd Cover
*Foster Engineering Co. —

Advertising forms of
MECHANICAL ENGINEERING
close on the sixth of the month preceding date of issue

Space reservations for advertisements to appear in the January issue should reach us not later than December 6th, copy and cuts by December 10th.

*Foxboro Co. (Inc.) —
Fulton Sylphon Co. 51

*Garlock Packing Co. 51
*General Electric Co. 9
General Radio Co. —
Goetze Gasket & Packing Co. —
Graham Transmissions (Inc.) —
Guardian Electric Mfg. Co. —
*Gwilliam Co. 52

Haering, D. W. & Co. —
Hamilton Mfg. Co. —
Heating and Ventilating Exposition, 7th International 46
*Hunter Pressed Steel Co. —
Hyatt Bearings Division, General Motors Sales Corp. 35
Hydraulic Controls (Inc.) 5

International Nickel Co. 10, 31

*James, D. O., Mfg. Co. —
Jenkins Bros. —
*Johns-Manville 37
Jones, W. A., Fdry. & Mach. Co. —
Jones & Lamson Machine Co. 52

Keuffel & Esser Co. 25
Koh-I-Noor Pencil Co. (Inc.) —
Kropp Forge Co. 6,7

*Leeds & Northrup Co. 16
Lincoln Electric Co. —
*Lobdell Car Wheel Co. —
Lovejoy Flexible Coupling Co. 50
Ludlow-Saylor Wire Co. —
Lunkenheimer Co. —

McGraw-Hill Book Co. —
*McKenna Metals Co. 39
Macmillan Co. —
Mears, Kane, Ofeldt (Inc.) 53

Morse Chain Co. 13

*National Airoil Burner Co. —
New Departure, Division General Motors Sales Corp. 1
Nordberg Mfg. Co. —
*Norma-Hoffmann Bearings Corp. 47
*Nugent, Wm. W. & Co. —

Ohio Nut & Bolt Co. 53
Ohmite Mfg. Co. 21
Ozalid Products Div., General Aniline & Film Corp. —

Pallet Sales Corp. —
*Pangborn Corp. —
Paragon Electric Co. —
Paramount Products Co. —
Pennsylvania Pump & Compressor Co. —
Permutit Co. 59
Philadelphia Gear Works 3
Phosphor Bronze Smelting Co. —
Pitman Publishing Corp. —
Polarizing Instrument Co. —
Post, Frederick, Co. —

Reeves Pulley Co. —
Reinhold Publishing Co. —
Rhoads, J. E. & Sons 48
*Robertson, John, Co. (Inc.) 47
*Roots-Connersville Blower Corp. —

*S K F Industries (Inc.) 4
*Skinner Engine Co. —
Smooth-On Mfg. Co. —
Squires, C. E., Co. 46
Standard Pressed Steel Co. 38, 49, 52
Stuart, D. A., Oil Co. (Ltd.) 20

Taylor Forge & Pipe Works 40
*Terry Steam Turbine Co. 45
*Timken Roller Bearing Co. 4th Cover
Tube-Turns (Inc.) 11

*Vogt, Henry, Machine Co. —
Voss, J. H. H., Co. —

*Westinghouse Electric & Mfg. Co. —
Wiley, John & Sons (Inc.) —
*Wing, L. J. Mfg. Co. —
Wood's, T. B., Sons Co. —

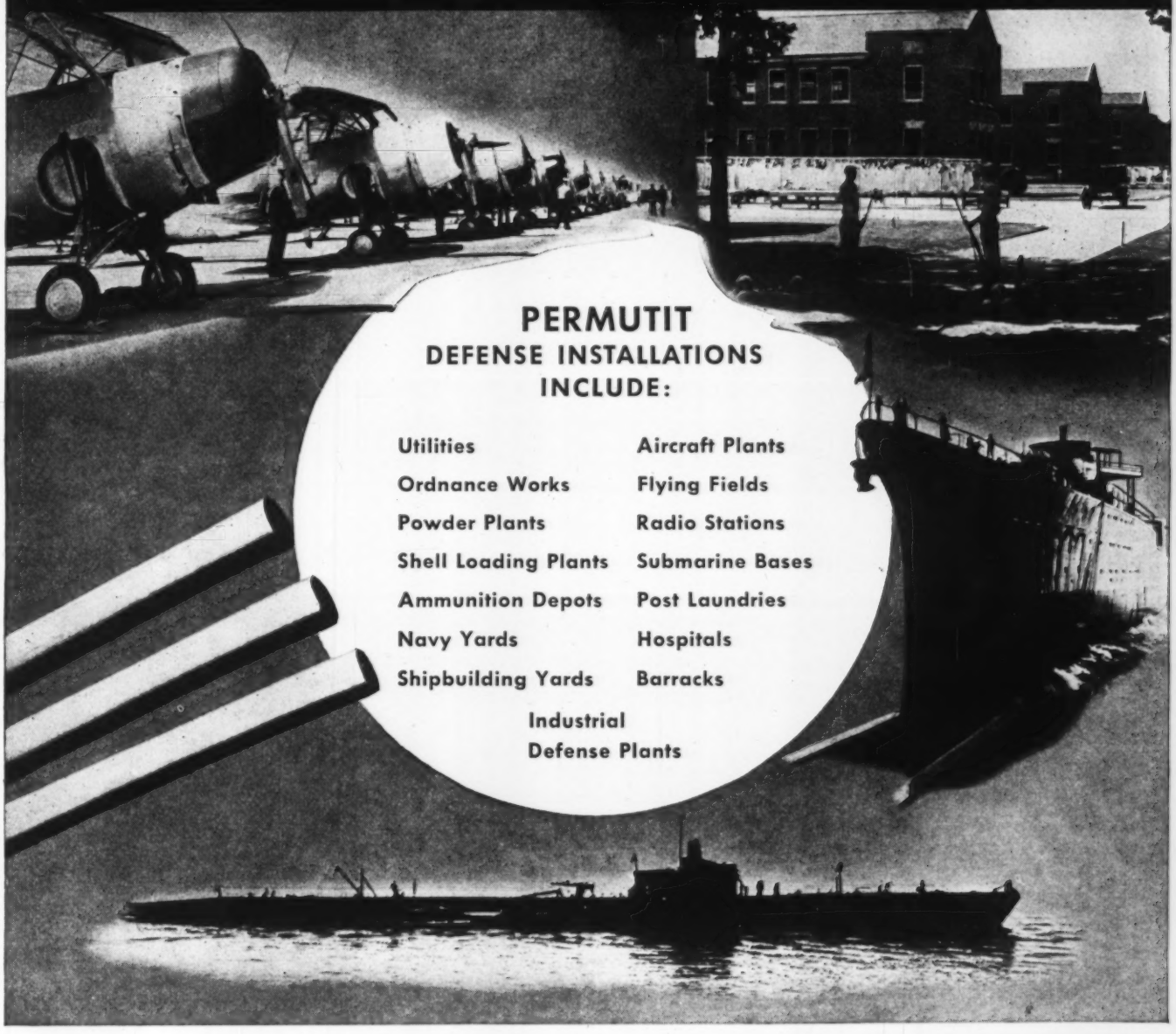
*Yarnall-Waring Co. 48

This list gives the names of display advertisers in MECHANICAL ENGINEERING during 1941

Advertising in this issue handled by Agencies

American Brass Co. — *Lord & Thomas, New York, N. Y.*
American Telephone & Telegraph Co. — *N. W. Ayer, Philadelphia, Pa.*
Arkwright Finishing Co. — *Horton-Noyes, Providence, R. I.*
Armstrong Machine Works — *Russell T. Gray, Chicago, Ill.*
Bantam Bearings Corp. — *Hazard Adv. Corp., New York, N. Y.*
Chas. Bruning Co. — *Buchen Co., Chicago, Ill.*
Buffalo Forge Co. — *Melvin F. Hall, Buffalo, N. Y.*
Philip Carey Mfg. Co. — *S. C. Baer Co., Cincinnati, Ohio*
Central Screw Co. — *Kennedy & Co., Chicago, Ill.*
Clarage Fan Co. — *Wm. J. Williams, Kalamazoo, Mich.*
Cleveland Worm & Gear Co. — *Paul Teas, Inc., Cleveland, Ohio*
Climax Molybdenum Co. — *Donahue & Coe, New York, N. Y.*
Cochrane Corp. — *Willard G. Myers, New York, N. Y.*
Darnell Corp. — *Henry L. Rhea Adv. Agency, Long Beach, Calif.*
De Laval Steam Turbine Co. — *George H. Gibson Co., New York, N. Y.*
Eagle-Picher Lead Co. — *Needham, Louis & Brorby, Chicago, Ill.*
Ethyl Gasoline Corp. — *Batten, Barton, Durstine & Osborn, New York, N. Y.*
A. W. Faber, Inc. — *Advertising Associates, Newark, N. J.*
Fairbanks, Morse & Co. — *Henri-Hurst & McDonald, Chicago, Ill.*
Fiske Bros. Refining Co. — *E. M. Freystadt Assoc., New York, N. Y.*
Fulton Sylphon Co. — *McLain Organization, Philadelphia, Pa.*
Garlock Packing Co. — *Hutchins Adv. Co., Rochester, N. Y.*
Heating and Ventilating Exposition — *O. S. Tyson & Co., New York, N. Y.*
Hyatt Bearings — *Campbell-Ewald, New York, N. Y.*
Hydraulic Controls, Inc. — *Chas. Daniel Frey Co., Chicago, Ill.*
International Nickel Co. — *Marschalk & Pratt, New York, N. Y.*
Johns-Manville — *J. Walter Thompson Co., New York, N. Y.*
Keuffel & Esser Co. — *Doremus & Co., New York, N. Y.*
Kropp Forge Co. — *Advertising Producers Associated, Chicago, Ill.*
Lovejoy Flexible Coupling Co. — *Merrill Symonds Adv. Service, Chicago, Ill*
McKenna Metals Co. — *Sykes Adv. Agency, Pittsburgh, Pa.*
Mears, Kane, Ofeldt — *R. E. Lovekin Corp., Philadelphia, Pa.*
Morse Chain Co. — *Fred M. Randall Co., Detroit, Mich.*
Norma-Hoffmann Bearings Corp. — *L. I. Wightman, New London, Conn.*
Ohmite Mfg. Co. — *Henry H. Teplitz, Chicago, Ill.*
Permutit Co. — *Newell-Emmett Co., New York, N. Y.*
Philadelphia Gear Works — *R. E. Lovekin Corp., Philadelphia, Pa.*
J. E. Rhoads & Sons — *R. E. Lovekin Corp., Philadelphia, Pa.*
John Robertson Co. — *R. E. Lovekin Corp., Philadelphia, Pa.*
Standard Pressed Steel Co. — *R. E. Lovekin Corp., Philadelphia, Pa.*
D. A. Stuart Oil Co. — *Russell T. Gray, Chicago, Ill.*
Taylor Forge & Pipe Works — *Kreicker & Meloan, Chicago, Ill.*
Tube-Turns, Inc. — *Farson & Huff, Louisville, Ky.*
Yarnall-Waring Co. — *McLain Organization, Philadelphia, Pa.*

Water conditioning by PERMUTIT* . . . a defense necessity, too!



Permutit feedwater treatment keeps boilers operating without shutdown . . . prevents losses not only in boiler time, but in generator or prime mover output. Today more than ever—under the strain of increased production—power plants rely upon Permutit for continuous operation at maximum efficiency.

Permutit makes every type of water conditioning equipment . . . prescribes treatment that exactly fits individual plant needs.

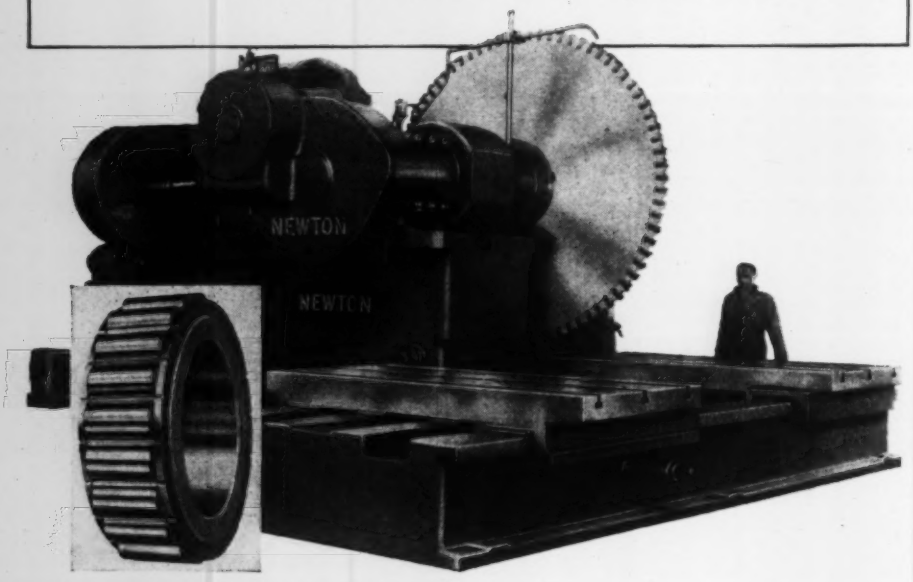
• • •

FREE ADVISORY SERVICE—Bring your water problem to Permutit for expert help. Write for free booklets: The Permutit Company, Dept. A3, 330 West 42d St., New York, N.Y. *Trademark Reg. U. S. Pat. Off.

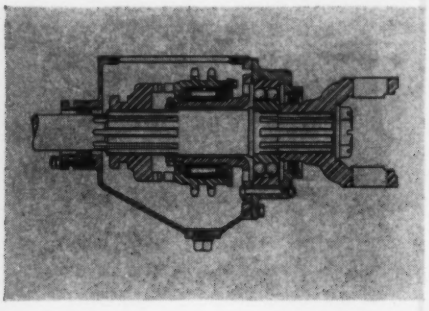
PERMUTIT WATER CONDITIONING HEADQUARTERS

IN THE NEWS

WITH BANTAM BEARINGS



TEN-FOOT CIRCULAR BLADE is a striking feature of this Newton Cold Saw Cutting-off Machine manufactured by Consolidated Machine Tool Corporation—probably the largest machine of its type ever built. Bantam Radial Roller Bearings were selected by Consolidated for use in this giant machine because of their compactness and high load capacity. Here is a typical instance of Bantam's skill in meeting novel design requirements.



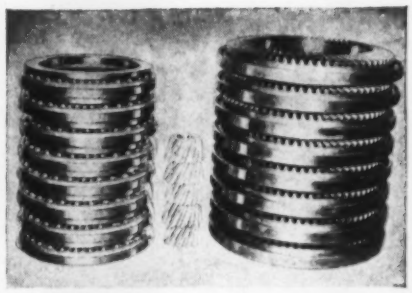
BANTAM SUPPLIES ANTI-FRICTION BEARINGS of many sizes and types to meet the requirements of Industry and Government for defense production. Because of Bantam's broad experience in the design and application of every major type of anti-friction bearing, Bantam engineers are exceptionally well qualified to undertake the solution of new and difficult bearing problems. For advice on anti-friction bearings, TURN TO BANTAM.

THIS COMPACT POWER TAKE-OFF is designed to take full advantage of the compact, space-saving features and high-capacity of Bantam's Quill Bearing. Built by Sterling Motors Corp. for use on heavy-duty Sterling trucks, it illustrates another application for this low cost anti-friction bearing. Completely self-contained, the Quill Bearing is admirably adapted to production-line assembly methods. For details on this unusual bearing, write for Bulletin N-104.

BANTAM BEARINGS

STRAIGHT ROLLER · TAPERED ROLLER · NEEDLE BALL

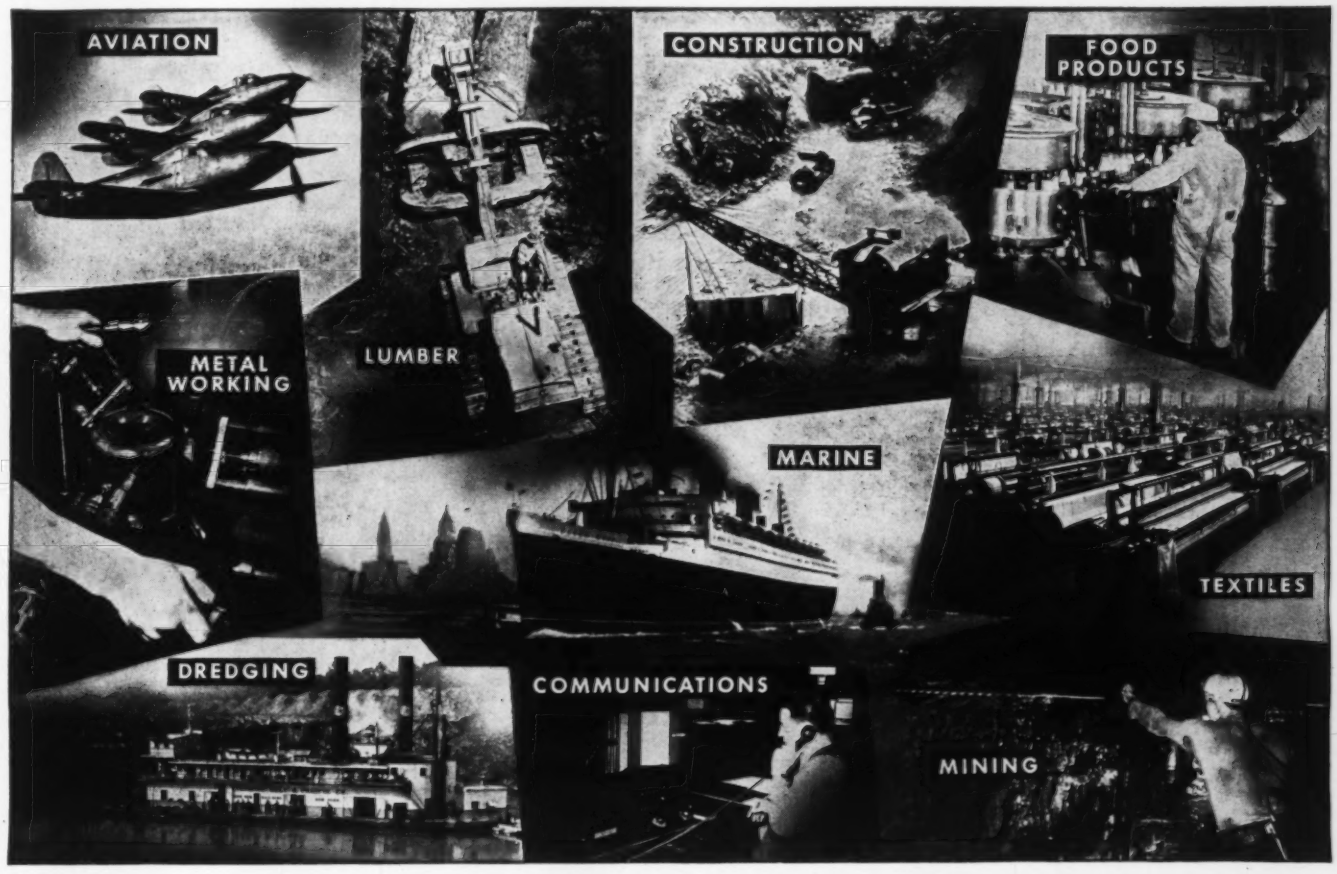
BANTAM BEARINGS CORPORATION • SOUTH BEND • INDIANA



FOR HEAVY-DUTY WELL DRILLING, Pennington Signaling Core Barrel's 12¾" oil-bath rotary offers outstanding advantages in capacity and economy. Photo shows Bantam Ball Thrust Bearings and drive gears which give this rotary a capacity of 70 tons at 100 RPM, permit it to be operated continuously at 600 RPM when drilling. "Bantam Bearings are precision-made," says Mr. Harry Pennington, "and we could ask for nothing better than what you furnish. Our products are also precision-made to take advantage of Bantam's accuracy."

4000-TON FORMING PRESS built by Baldwin-Southwark is powered by two Oilgear Two-way Variable Displacement Pumps with a combined displacement of 143 gallons of oil per minute at pressures up to 3,000 pounds per square inch. Each pump rotor turns on large Bantam Radial Roller Bearings—7.0866" I.D. for front rotor bearings, 9.0551" I.D. for rear rotor bearings.

HOW LUBRIPLATE SPEEDS NATIONAL DEFENSE



On land—on sea—in the air—in every phase of industry vital to defense, LUBRIPLATE lubricants are doing jobs that are nothing short of amazing. From a smear on the worm screw of the naval officer's binoculars to a ton of LUBRIPLATE in the dredge underwater gear case—against friction and wear—thwarting rust and corrosion—conserving bearings and parts—LUBRIPLATE carries on. In spite of heat and high water—tractors and trucks rolling through muck and mud—spotless food packing machines constantly washed with scalding water—textile spindles whirling faster than ever before—marine equipment exposed to highly corrosive sea-water and spray—LUBRIPLATE lubricants perform under conditions that would stop ordinary lubricants cold.

LUBRIPLATE DIVISION
FISKE BROTHERS REFINING COMPANY

Newark, N. J. Toledo, Ohio

DEALERS FROM COAST TO COAST

LUBRIPLATE

THE MODERN LUBRICANT *that Arrests Progressive wear*

This Gisholt No. 12 Hydraulic Automatic Lathe with Timken Bearing Equipped spindle is machining forged steel (SAE 4150) Diesel engine injector bodies. It does an all-over job in one operation in a floor-to-floor time of 6 minutes. The same work previously necessitated 2 operations requiring a floor-to-floor time of just over 10 minutes. Thus machining time has been cut 42%; production stepped up 72½%. To achieve the same results by the previous method, 2 of the older type machines would have been required.

The increased production made possible by the single Gisholt Lathe not only satisfies assembly line demand, but releases greatly needed floor space and man power for other work.

With manufacturers constantly on the alert to take advantage of the advantages offered by modern Timken Bearing Equipped machinery the success of the National Defense Program is assured—and so is the future of American industry.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS

Manufacturers of Timken Tapered Roller Bearings for automobiles, motor trucks, railroad cars and locomotives and all kinds of industrial machinery; Timken Alloy Steels and Carbon and Alloy Seamless Tubing; and Timken Rock Bits.